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IN THIS ISSUE . . . .

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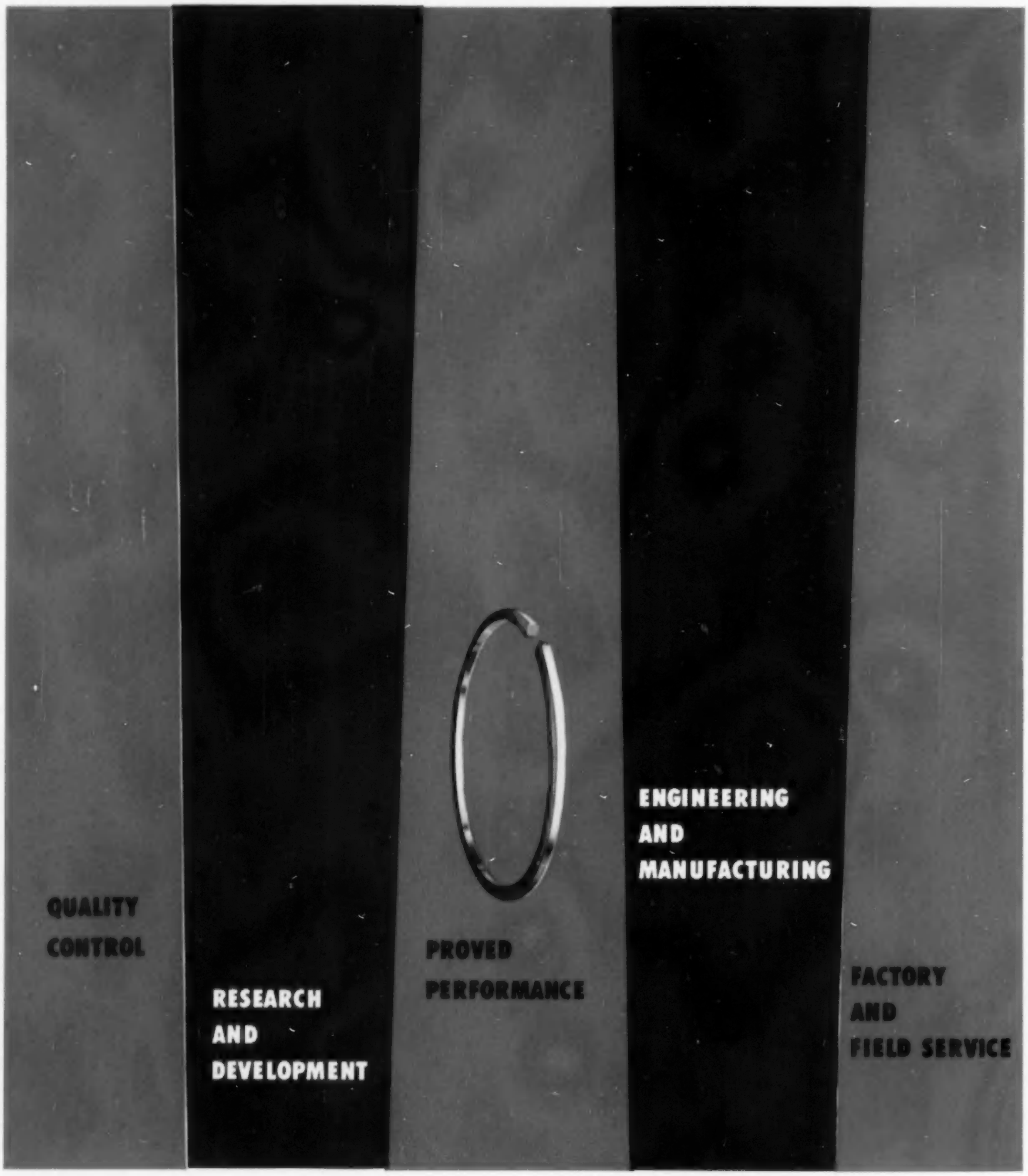
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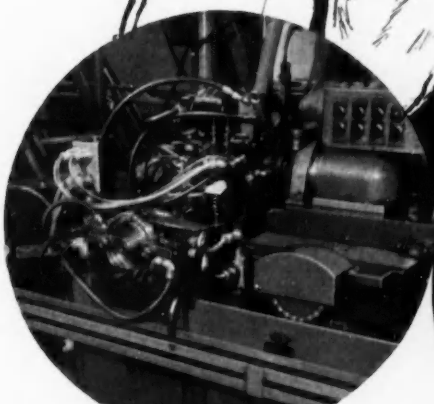

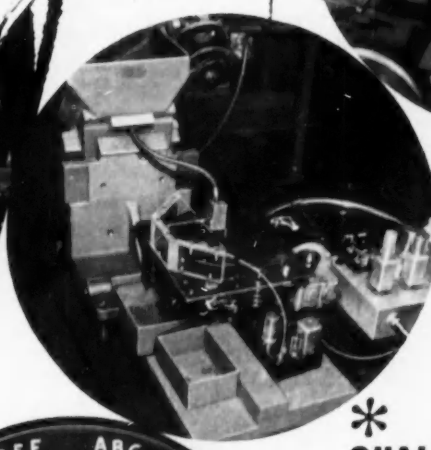

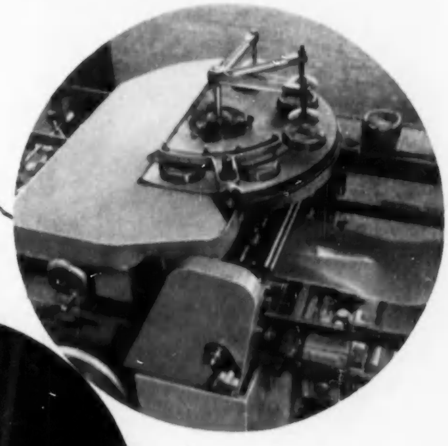

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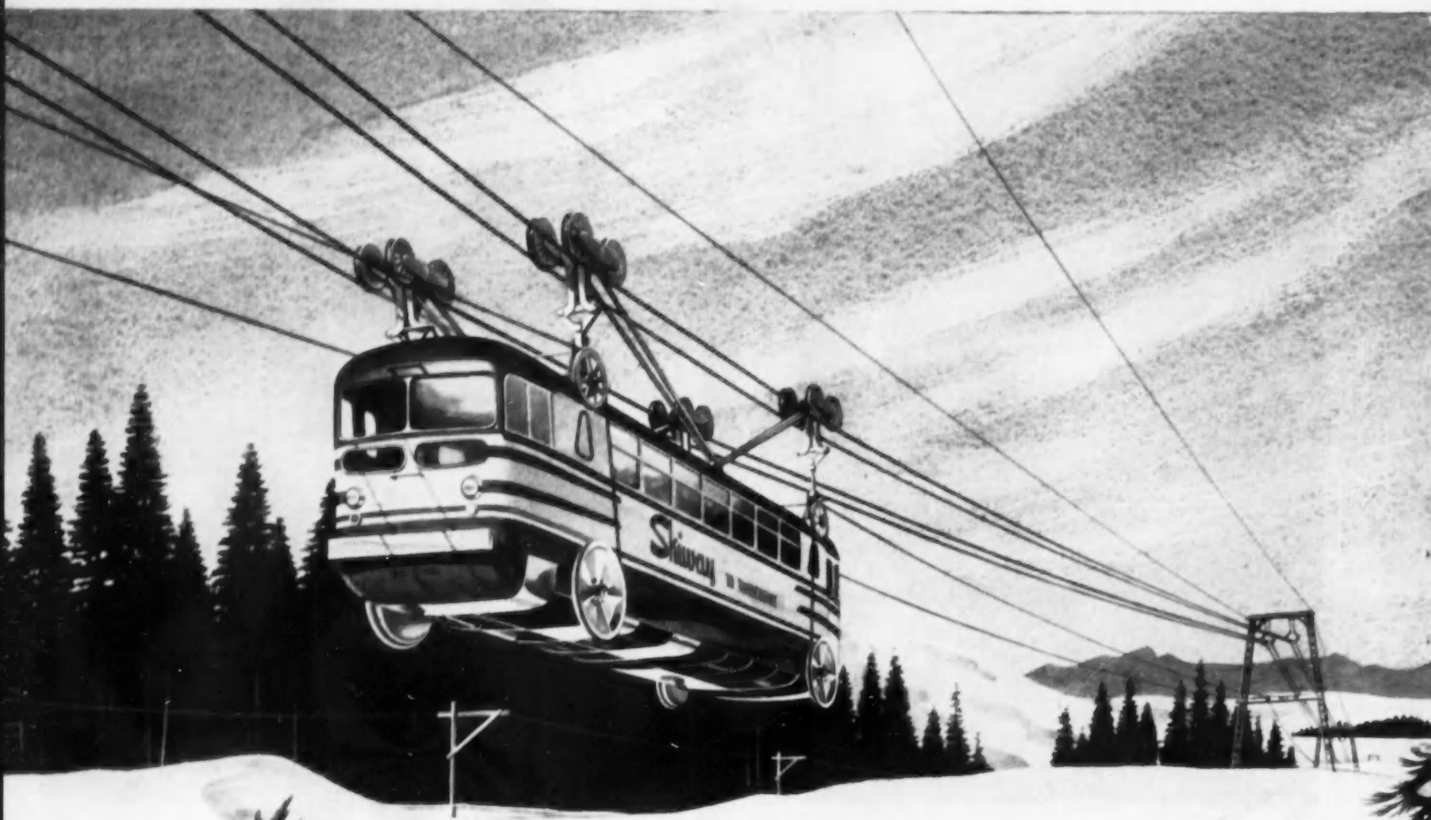
Spicer comes through in the long



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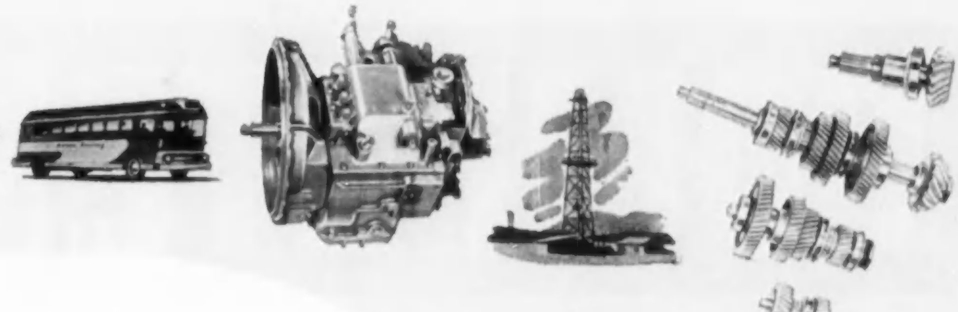

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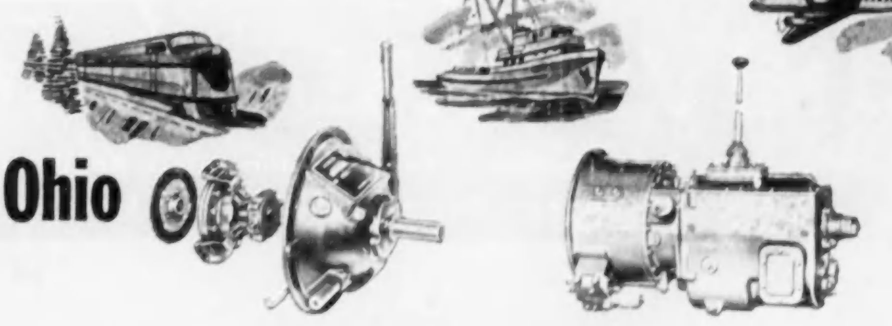
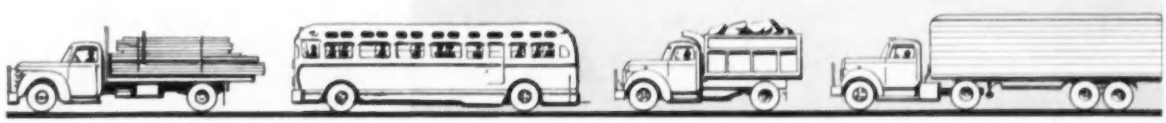


Toledo 1, Ohio

Little Item Big Saving



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For the Sake of Argument

Patterns and Textures . . .

By Norman G. Shidle

Differences of opinion, like pieces of cloth, have texture as well as pattern. . . . And the texture, as much as the pattern, gives quality to the discussion.

Sometimes, differences can exist peacefully side by side. Wise men usually let them lie when no clear end is served by bringing them face to face. Such men air differences only when they know why. They are wary of subconscious desires to win an argument or to fortify tottering inner convictions.

But, in everyday work, differences rarely can be buried without interring potential achievement as well. Resolution of differences with associates is an integral part of a working life.

It's when we have to resolve differences that "texture" becomes as important as "pattern."

Pattern reflects the character of the differences; texture, the character of the discussion about them. Pattern is what everybody sees; it is the "what" of differences. Texture is the "why"—springing, as often as not, from emotional wells deep within us.

Differences stated by suspicious or antagonistic men tend to remain differences, regardless of overt aims or patterns. The same differences, stated by men completely focused on a common end, tend steadily to melt away.

"Differences lost their tensions," we heard a prominent divine say recently of the progress of an interfaith religious conference.

When tensions go out of differences, the texture changes. They become soft to the touch; pleasant to be wrapped in.

The pattern, oftener than the texture, is of highest quality in our expounding of everyday differences.

SAE journal

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1905 GOLDEN ANNIVERSARY 1955

Contents—March, 1955

Society of Automotive Engineers, Inc.

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Turbojet Transports in Air Force Future

T. V. Jones,
Northrop Aircraft, Inc., and the Aircraft Design Section of The Rand Corporation

Based on paper "Capabilities and Operating Costs of Possible Future Transport Airplanes," presented at SAE Los Angeles Aeronautic Meeting, October 7, 1954

AIR Force transport planes ten years from now will probably be larger, have a longer range, be powered by turboprop engines, and be operated at lower direct operating cost. These predictions come from a current analysis of design capabilities and operating costs of possible future transport airplanes. They're based on the following general theories:

1. Large airplanes have lower direct operating cost per ton-mile than small airplanes. And, their range can be varied with less adverse affect on cost per ton-mile and lifting capacity.

2. Turbo prop engines give lower direct operating cost per ton-mile than reciprocating or turbojet engines for any combination of design, payload and range.

3. The cruising speed which gives the lowest direct operating cost per ton-mile depends on the type of engine, but is independent of payload and range.

4. Selection of a preferred airplane must consider the cost of a fleet of airplanes to do the total logistical job, rather than the cost of one airplane to do one payload-range job well.

Of course, any radical discoveries within the next few years may change the picture. And the necessary engine and airframe development must be started now to be operational in 8 to 10 years.

Seek Maximum Airlift at Lowest Cost

The purpose of this analysis is to get information that will enable designers to achieve maximum airlift capacity at the lowest direct operating cost per ton-mile.

The direct operating cost per ton-mile can be expressed as a Cost Index

$$\text{Cost Index} = \frac{\text{Direct operating cost}}{\text{Block Speed} \times \text{Payload}}$$

Direct operating costs include fuel, oil, flight and maintenance crew time, initial cost of aircraft and spare parts actually used by the plane.

Block speed is an average speed in knots obtained from dividing the distance travelled by the time elapsed between starting and stopping the engines.

Payload is the maximum tons that can be carried for the particular range.

From this formula one can see that an airplane flying at 400 knots can cost twice as much per flying hour as an airplane flying at 200 knots with the same payload. Yet the cost index is the same.

The direct operating cost per ton-mile and the take-off weight have been determined for many theoretical airplanes. The planes have been designed to differ from each other in at least one of the following characteristics:

Design-point Payload
Design-point Range
Design Cruising Speed
Required Field Length
Engine Type

Let's look at their effects on cost index and take-off weight.

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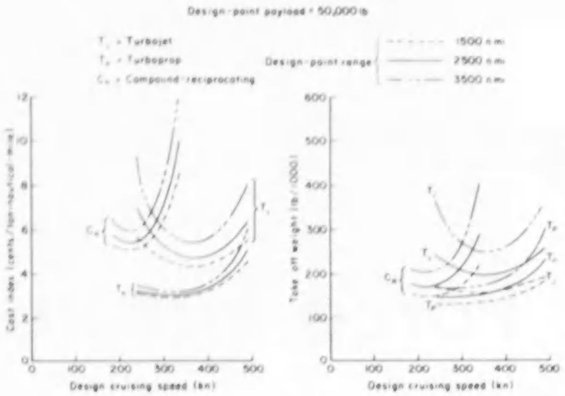
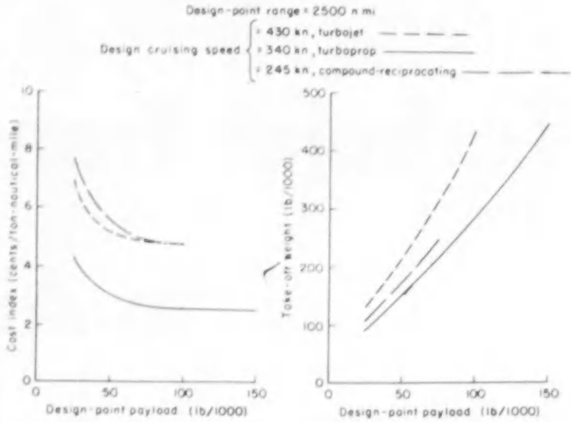
Design Cruising Speed



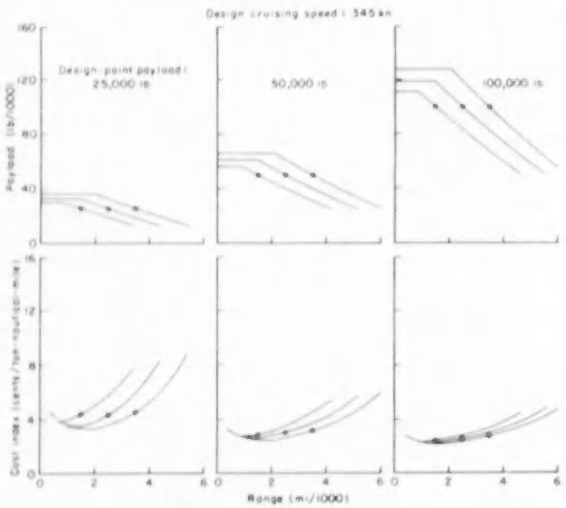
Design cruising speed which gives the lowest cost index is different for each engine type: 225 knots for the compound reciprocating (C_R) 330 knots for the turboprop (T_P) and 370 for the turbojet (T_J). At their best speeds on the same design mission, the turbojet weighs considerably more than the compound reciprocating. But it has the lower cost index. *For all design speeds and ranges, the turboprop aircraft has the lowest take off weight and lowest cost index.*

Design-Point Payload

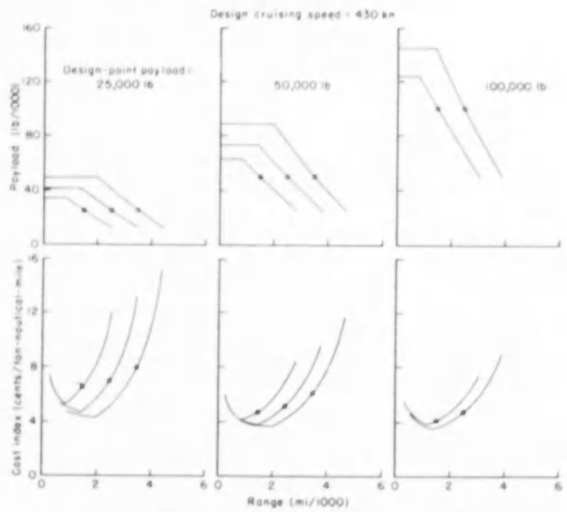


This shows the cost index and take-off weight versus design point payload for aircraft having the same design range, field length, cargo density and cruising speed. For light payloads there is a very sharp decrease in operating cost index as payload is increased. But at large payloads (100,000 to 150,000 lb) there is negligible reduction in cost index. Aircraft take-off weight increases almost linearly as design-point payload is increased.

Payload and Cost Index at Ranges Other Than Design-Point Range



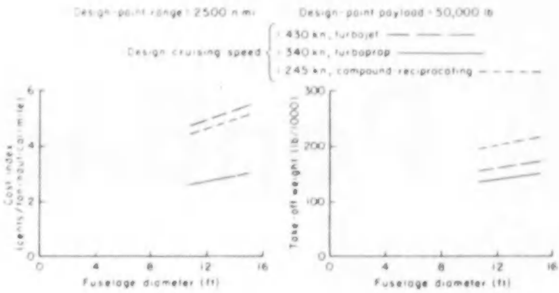
This shows the payload and cost index for a number of turboprop airplanes having different combinations of design-point payload and design-point range but the same design cruising speed of 345 knots.



These are similar curves for turbojet aircraft which have a design cruising speed of 430 knots. Each line represents a single airplane. The design points are encircled.

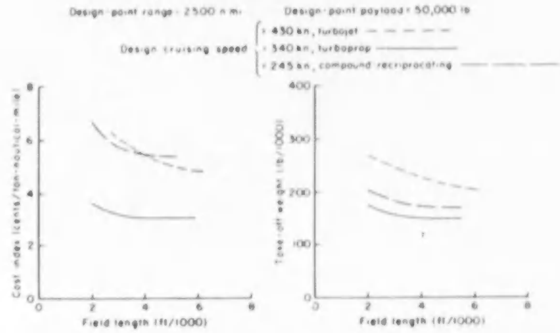
On the payload range graphs the sloping lines through the design points are lines of constant take-off weight and show the results of exchanging fuel and payload. The lines of constant payload show the greatest loads that the airplanes are designed to carry. Thus, aircraft designed for longer ranges and higher payloads (e.g. larger aircraft) have cost indices which are lower and much less sensitive to operating range than those of aircraft designed for lower payloads and shorter ranges (e.g. smaller aircraft).

Cargo Density



There is sizeable increase in take-off weight and cost index as fuselage diameter is increased. This is because the larger fuselage increases aerodynamic drag, requiring larger powerplants and more fuel and, hence, larger aircraft for the same mission.

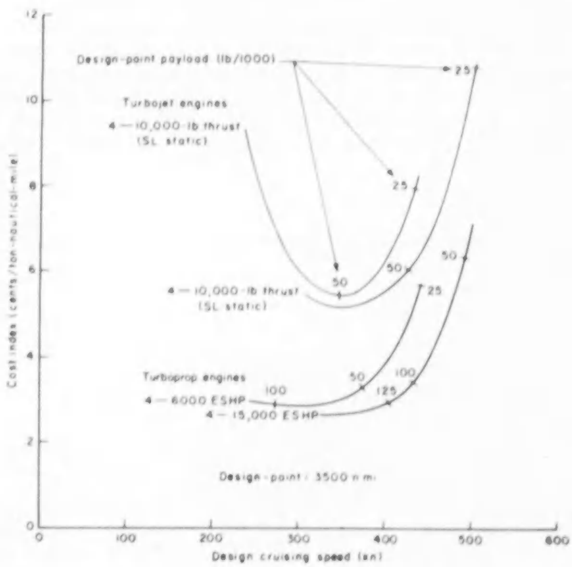
Field Length Requirement



Cost index and weight of the turbojet aircraft decrease as field length requirements are increased. The turboprop and compound reciprocating aircraft, however, tend to reach their lowest cost index with field lengths about 4000 ft. This indicates that future transport aircraft need not depend on extra-long runways to get a low cost index.

Engine Size

The cost indices of aircraft powered with larger engines, both turboprop and turbojet, are lower and less sensitive to variation in cruising speed than those of aircraft powered with smaller engines. Above 440 knots the larger turbojets give a lower cost index than the smaller turboprop. However the larger turboprop has a lower cost index than the larger turbojet at all speeds. All aircraft being considered have a design-point range of 3500 nautical miles and 4500 ft field length, and the same cargo density. But the design-point payload changes as the design speed is varied, as indicated by the notations along each curve.



Cost Index Is Not Sole Criterion

Although cost index is a help in choosing a preferred airplane for future transport duties, other factors should also be considered. Indirect costs, such as hangars, tools, airbases, and administration are important. The fact that airplanes may often be operated at less payload than they are able to carry and for distances different from the design point ranges, will change the overall cost of operating a fleet of airplanes.

(Paper on which this abridgment is based is available in full in multilithographed form from SAE Special Publications Department. Price: 35¢ to members, 60¢ to nonmembers.)

The New Pontiac

PONTIAC'S 1955 V-8 is new from the engine mounts up. All the components have been designed or modified to give an engine that is compact, rigid, and adaptable to future changes in displacement and fuel requirements. The general arrangement of the engine was planned to simplify manufacturing and allow easy access for servicing.

Fig. 1 is a picture of the new "Strato-streak" V-8. The entire exhaust system, including manifolds and connecting pipe, has been kept low to allow easy access to the spark plugs from the top of the engine. The generator is on top of the engine, between the cylinder heads, where it is protected from exhaust heat and accessible for servicing. A single belt drives the generator, water pump and fan. An optional full flow oil filter is in a vertical position to aid servicing without spilling oil.

The combination fuel and vacuum pump is mounted low on the forward left hand side to discourage vapor lock and permit connection to the fuel line. Since the right hand bank of cylinders is forward, the pump can be placed in this corner, close to the engine centerline, where it is driven directly by the eccentric on the camshaft. The distributor gear is on the right hand side of the camshaft resulting in an upward thrust on the driven gear. This obviates the need for a separate surface in the block.

The Engine Is Compact

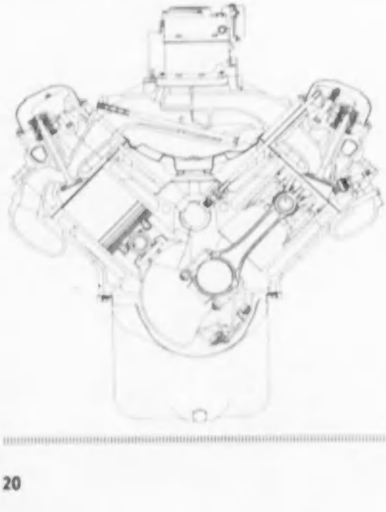


Fig. 2—Transverse cross section shows compactness of new engine

The combination of 3.75 in. diameter bore and 3.25 in. stroke was helpful in getting minimum external dimensions for the 287 cu in. displacement. The large bore makes possible ample valve sizes, and the short stroke results in low friction and wear. There are three rings on the aluminum piston. The overall height of the engine is small enough to permit a low hood silhouette.

The distance from the centerline of the crankshaft to the top surface of the intake manifold is only 13.9 in. The 5-in. carburetor adds another few inches. A transverse cross section of the engine is shown in Fig. 2.

Fig. 1—The "Strato-streak" V-8 was designed for simplicity

V-8

After nine years of design and development, Pontiac introduces its first overhead valve V-8 engine.

C. B. Leach and E. L. Windeler, Pontiac Div., General Motors Corp.

Based on paper "The New Pontiac V-8 Engine," presented at the SAE Golden Anniversary Annual Meeting, Detroit, Jan. 12, 1955.

The Engine Is Rigid

The inherent structural rigidity of the cylinder block makes possible the placing of the oil pan flange at the centerline of the crankshaft. There is a thrust type seal at the front of the crankshaft; at the rear, a slinger and rope-type seal. Fig. 3 is a longitudinal section of the engine showing other details of engine construction.

The crankshaft has a main bearing journal diameter of 2.5 in. and crankpin diameters of 2.25 in., resulting in a .76 in. overlap. Its natural frequency of torsional vibration is 350 cps. The five main bearings are supported by rigid bearing caps, doweled in position and attached to ribbed bulkheads of the cylinder block.

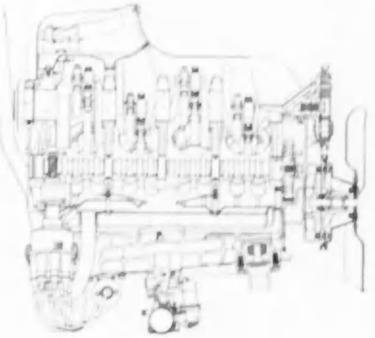


Fig. 3—Longitudinal cross section shows details of engine construction

Please Turn Page

Casting Is Simplified

By carefully integrating a new casting concept into the design of the engine it was possible to simplify the casting of the cylinder block and heads. The new method results in manufacturing economies, more uniform castings and a more functional design.

The number of cores was reduced from 34 to 16. The total weight of the dry sand cores was reduced from 320 lb to 158 lb. The cores were fixture set directly into the mold, reducing the probability of core shift during pouring. It makes possible the lowest weight castings consistent with quality production.

Valve Train Designed For Long Life

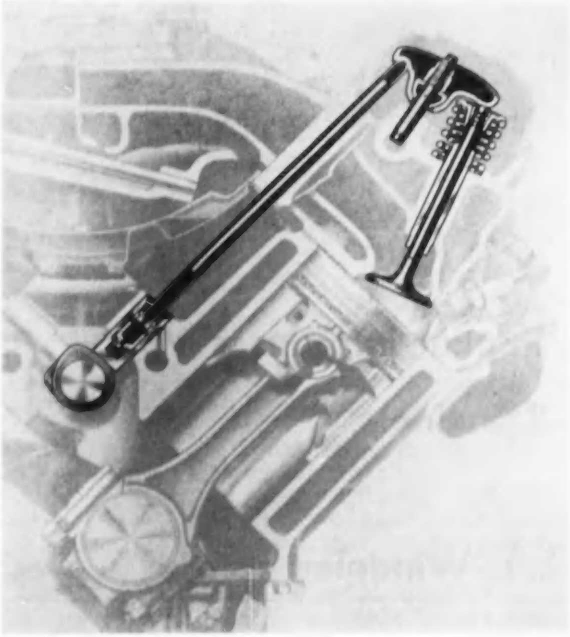


Fig. 4—Valve train was designed in 1948, but hydraulic valve lifters are new this year

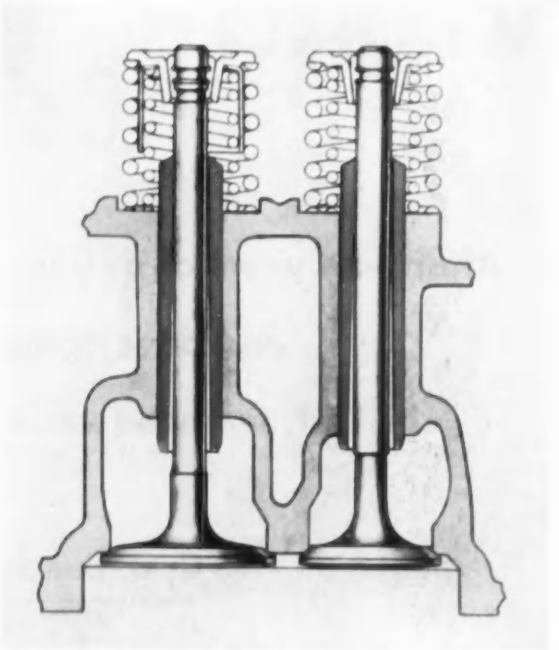


Fig. 5—Tapered valve stem guides prevent oil from flowing down the intake valve guide under high vacuum conditions

The valve train used on the new engine was designed by Pontiac in 1948. It is shown in Fig. 4. The rocker arm pivots on a ball which makes sure that the rocker arm contacts the valve-stem end squarely. This prevents misalignment of the rocker arm with the push rod and reduces valve cocking.

The ball pivot is pressure-lubricated by oil entering the ball from a drilled hole in the stud which connects with the oil gallery in the head.

New this year are hydraulic valve lifters. The use of dual valve springs and rigid valve gear components has resulted in a valve lifter "pump up" speed of 5000 rpm. Tapered valve stem guides (as shown in Fig. 5) have been held over from the old engine. The close clearance at the top prevents oil from flowing down the intake valve guide under high vacuum conditions. The larger clearance at the lower end allows for expansion for the hot valve stem. It also allows a certain amount of freedom for the proper seating of the valve. This self-centering freedom, combined with the reduced cocking tendency of the ball pivot rocker arms, has resulted in reduced valve stem and valve guide wear.

The intake valve head diameter is 1.781 in. and has a 30 deg seat angle. The exhaust valve diameter is 1.500 in. with a 45 deg seat angle. These valve sizes and the .367 in. valve lift contribute to the performance of the engine.

Cooling System Gives Low Valve Seat

The cooling system is a variation of the old straight-eight "gusher valve" set-up, in which cold water is ejected at high velocity from holes in the distributing tube in each cylinder head. This water scours the surface of the valve ports around the valve seats and absorbs heat quickly.

In this system the complete flow from the water pump is used to cool positively the hottest and most critical region in the engine. Fig. 6 shows details of the system. The flow rate through the radiator core of the 1955 engine has been increased about 30% over that of the 1954 inline engine.

During warm-up, when the thermostat is closed, the large amount of recirculation quickly raises the temperature of the cold cylinder walls. Condensation is thus decreased and lubrication is made more effective during this critical period of operation.

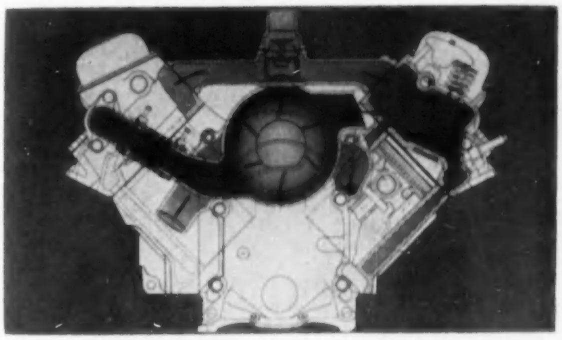
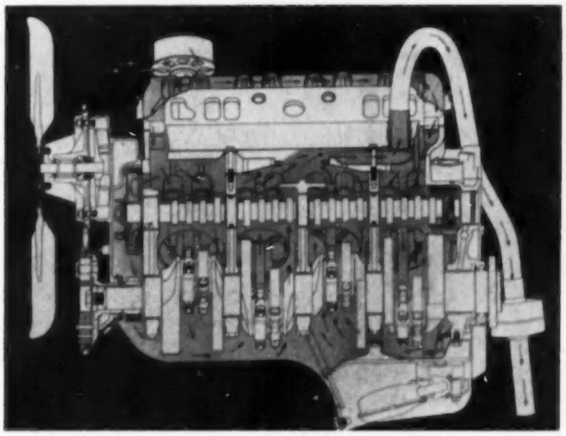


Fig. 6—Cooling system permits the complete flow from the water pump to cool the hottest and most critical regions in the engine

All Engine Compartments Are Ventilated Temperatures



The engine ventilation system was designed to be more than just a crankcase ventilation system. It also scavenges harmful corrosive diluents from all compartments of the engine. As shown in Fig. 7, fresh air is fan-driven through the valve covers, and into the crankcase and timing chain cavity. It circulates through a baffle and oil settling chamber which traps oil vapor and exhausts through a rear-mounted suction-type air outlet. With this system there is positive pressurized air flow under all engine operating conditions and little oil loss. Double air inlets (which can be used for filling oil) allow ample air to enter the engine, even during idling.

Fig. 7—Engine ventilation system scavenges harmful corrosive diluents from all compartments of the engine

Intake Manifold Distributes Fuel

The intake manifold was designed so that the runners are approximately equal in length and large enough to match the breathing capacity of the entire induction and exhaust system. The flow of exhaust gas is regulated by a thermostatically controlled valve in the right side exhaust manifold.

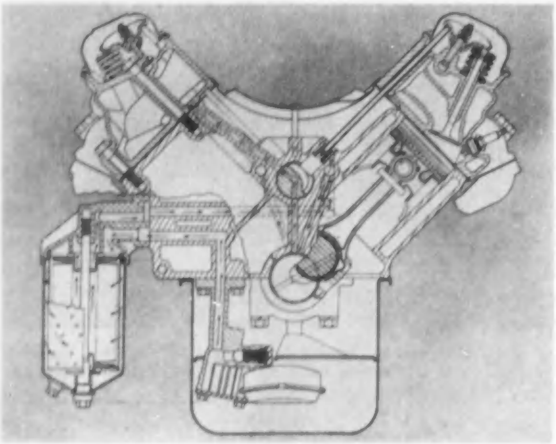
During warm-up, exhaust gases are formed through the center exhaust passages under the risers to assure vaporization of the fuel.

12 v Electrical System

A 12 v electrical system has replaced the 1954 6 v system for many reasons. The available voltage is now always ample to assure proper ignition of the charge. At −10 F, a 12 v starting motor gives 16% faster cranking speed than a 6 v motor. And a 12 v generator develops 300 w as compared to 270 w put out by the 1954, 6 v generator. This 11% increase is accomplished with a generator of the same diameter, but 1 in. shorter than the 1954, 6 v model.

Please Turn Page

The Lubrication System Uses Oil Galleries



The lubrication system of the new engine is shown in Fig. 8. An oil pan baffle completely covers the five quart sump area and minimizes aeration by oil thrown from the crankshaft. Oil is pumped to the optional flow oil filter and then to the left hand oil gallery. Main crankshaft bearings receive oil through holes drilled into this gallery. Connecting rod bearings are fed from main bearing journals through drilled holes in the crankshaft.

The lubrication of the distributor lower bushing and drive gear is accomplished by gravity feed, as shown in Fig. 9. The oil pump uses coarse pitch helical gears for quiet, high capacity operation.

A ball relief valve maintains constant pressure throughout most of the speed range.

The cylinder walls are lubricated by a stream of oil from the connecting rod, as shown in Fig. 10. The oil also sprays the interior of the piston and lubricates the piston pin.

Fig. 8—(above left) Lubrication system oil pan completely covers the sump area and minimizes aeration by oil thrown from the crankshaft

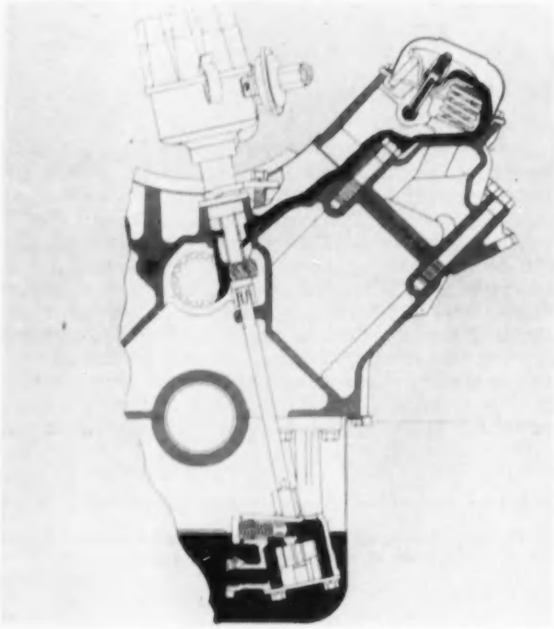
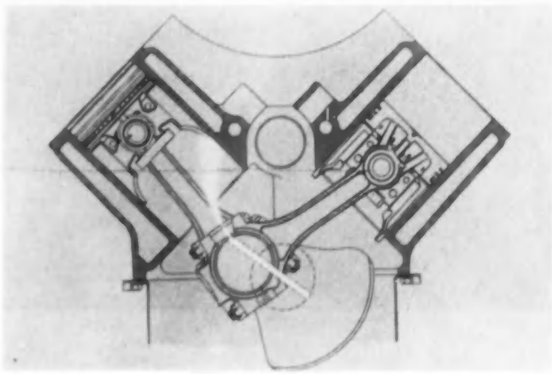
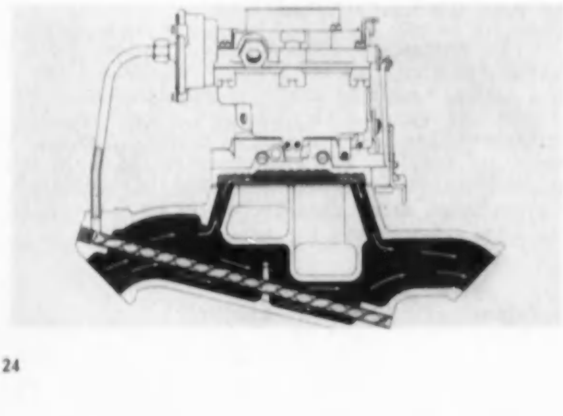


Fig. 9—(below left) Distributor lower bushing and drive gear are lubricated by gravity feed

Fig. 10—(below right) Cylinder walls are lubricated by spraying a stream of oil from the connecting rod



Carburetor Choke Stove Helps Warm-Up



A carburetor choke stove, Fig. 11, in the center exhaust passage of the intake manifold, transfers heat from the exhaust gas to the air being supplied to the choke by engine vacuum. A helical baffle inside the tube increases the heat transfer. The de-icing passage which channels hot exhaust gas under the idling jets prevents ice formation.

Fig. 11—A carburetor choke stove in the intake manifold transfers heat from the exhaust gas to the air being supplied the choke

Combustion Chamber Is Wedge Shaped

The wedge-shaped combustion chamber, Fig. 12, is completely machined for accurate control of compression ratio. The thin quench area covers 35% of the piston head area; turbulence is thus promoted and effective flame travel is shortened. This type of chamber was chosen because it gives a better combination of output and fuel economy than any other type. The wedge shape is also adaptable to future compression ratio increases.

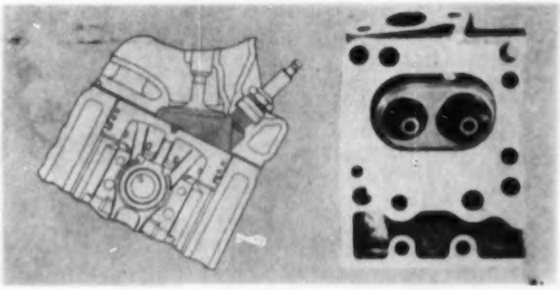


Fig. 12—Wedge-shaped combustion chamber gives a better combination of output and fuel economy

Engine Is Matched To Fuels

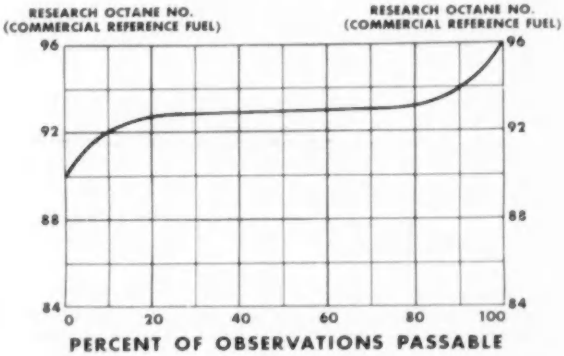


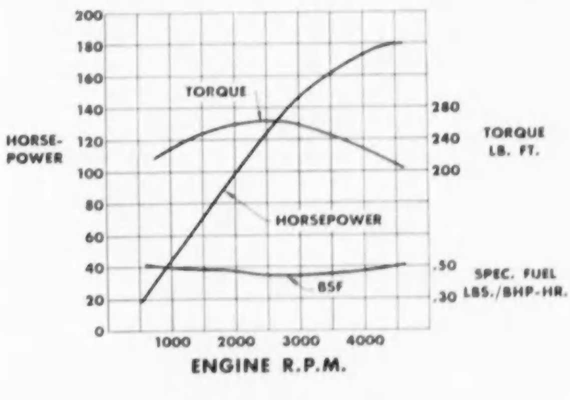
Fig. 13 shows the octane requirements of the 8 to 1 compression ratio engine when used with the Hydra-Matic transmission. In a test range of 3000 to 7500 miles, using 93 Research Octane number fuel, 80% of the requirement observations found no evidence of knock. When 96 octane fuel was used, 100% of the observations found no knock. Since most premium fuels today have Research Octane numbers of from 93 to 96, the new engine is well matched to the fuel available.

Fig. 13—The octane requirements of the 8 to 1 compression ratio engine are depicted here. Using 93 Research Octane number no evidence of knock was found in 80% of the observations

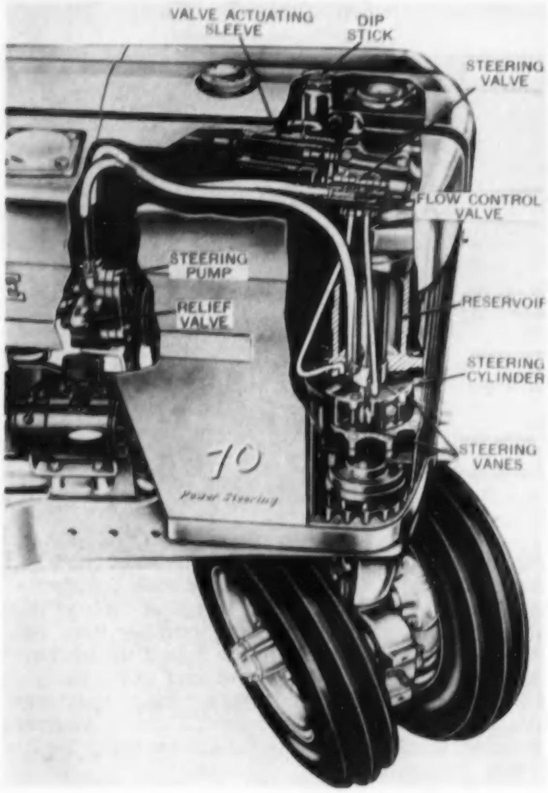
More Power Provided

The full throttle performance of the Pontiac V-8 is shown in Fig. 14. 180 bhp is attained at 4600 rpm. Maximum torque of 264 lb-ft at 2400 rpm is developed by a bmep of 139 psi at this speed. Maximum specific output is .627 bhp per cu in. of displacement. Minimum brake specific fuel consumption is .45 lb per bhp-hr.

Fig. 14—Full throttle performance data of the Pontiac V-8



(The paper on which this abridgment is based is available in full in multilithographed form from SAE Special Publications Department. Price: 35¢ to members, 60¢ to nonmembers.)



Power Steering

POWER steering on tractors can make the farmer's work easier, more productive and safer. Only it must be designed to meet stringent operating requirements. Here's John Deere's power steering system and the reasoning behind its design.

Integral Gear Hydraulic System

Hydraulic power was chosen as better adaptable to farm tractors than electrical, mechanical or pneumatic power steering.

An integral gear system was chosen rather than a linkage type. The low slung cylinders, fluid lines, and valves of the linkage type would reduce clearance under the tractor, are vulnerable to damage, and interfere with implements and crops. The integral type has relatively simple fluid lines and costs less.

A vane power cylinder is used instead of a ram type because of space limitations and the opportunity to connect it directly to the steering spindle. Full capacity is available in all positions, torque is transmitted to the front wheels simply, and full turn rotation is possible in either direction.

The vane cylinder consists of a stationary vane, which is mounted on the housing immediately above the front wheels, and a moving vane, which is attached to the steering spindle. Pressure acting between the moving and stationary vanes creates the torque on the steering spindle. Pressure may act on either side of the vanes.

The steering valve (see Fig. 1) and the valve actuating mechanism is at the top of the steering spindle near the steering worm. The valve is an open center sleeve type valve.

The valve actuating sleeve is splined to the steering shaft. Relative rotation between the sleeve and the steering worm moves the sleeve forward or backward. This is done through a special screw which engages a helical groove in the worm shaft. The fore and aft motion of the sleeve is transmitted to the steering valve by an actuating arm.

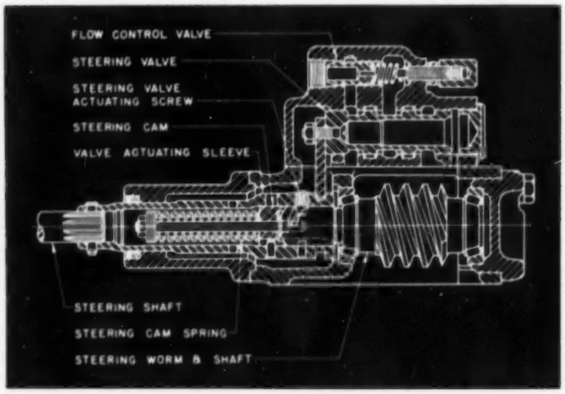


Fig. 1—The steering valve, its actuating mechanism, and the flow control valve are in the same housing on top of the steering worm

for Tractors

Here's How John Deere's System Works

C. Hess, L. Ethington, R. Giertz,
John Deere, Waterloo Tractor Works

Based on paper "Adaptation Of Power Steering To A Line Of Agricultural Wheel Tractors," presented at SAE National Tractor Meeting, Milwaukee, Sept 15, 1954

A flow control valve in the steering valve housing provides a constant flow rate to the system regardless of engine speed.

Operation

The power steering system, which is shown in Fig. 2, operates this way:

1. **When there is no steering action** the pump draws the oil from the reservoir and discharges it to the flow control valve. Some is bypassed to the reservoir and the remainder enters the steering valve. From the center of the valve the oil flow is divided past each of two lands on the valve into the discharge passages and then to the reservoir. When there is no steering action there is no pressure in the steering cylinder.
2. **In making a right turn** the clockwise rotation of the steering wheel is transmitted through the steering shaft to the valve actuating sleeve. Relative rotation between the sleeve and the worm produces rearward motion of the steering valve.

As the valve moves back, the steering valve inlet passage is communicated with the rear valve-to-cylinder line, which in turn communicates to the left side of the stationary vane. At the same time

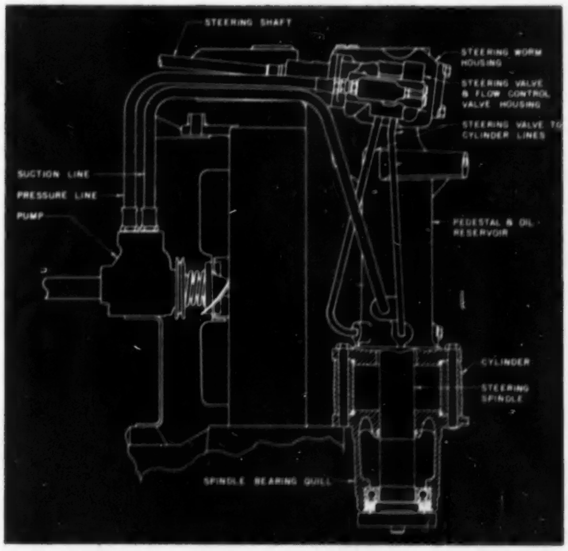


Fig. 2—The John Deere power steering system is composed of steering cylinder, hydraulic pump, oil reservoir, steering valve, flow control valve, and connecting lines

the forward valve-to-cylinder line is communicated with the discharge passage in the valve and then to the reservoir.

As the steering valve moves rearward by increasing the relative angular error between the sleeve and the worm, the pressure continues to increase until it overcomes the resisting torque on the steering spindle. Then the spindle and worm gear turn, permitting the steering worm to turn.

As long as the steering motion continues, the shaft and the steering worm will rotate together with no change in error. When the steering motion is stopped, the pressure differential still remains in the cylinder, so the spindle continues to rotate. Now, with the shaft stationary and the worm rotating, the error in angular position between the two parts will decrease and the pressure in the cylinder will be reduced accordingly. The spindle will continue to rotate until the cylinder pressure drops below that required to overcome the resisting torque on the spindle. The steering valve will then be at neutral.

For a left turn the steering valve moves forward, the front valve-to-cylinder line becomes the pressure line and the rear line becomes the return.

Road reaction is absorbed by the power system rather than the operator. An obstruction striking a front wheel causes a slight rotation of the spindle, worm gear, and steering worm. Since the steering wheel is held stationary, this introduces an error in relative angular position between the worm and sleeve, causing steering valve movement. Oil is admitted to the appropriate side of the steering cylinder until the applied torque balances the torque on the spindle. After the obstacle has passed, the spindle returns to its original position due to the pressure differential in the cylinder, and the steering valve returns to neutral.

Manual steering has not been eliminated entirely so that the tractor can be steered while being towed or when the engine is not running. A pin in the actuating sleeve, working in an oversize keyway in the steering worm shaft, provides a direct connection between the steering shaft and steering worm for manual steering.

Performance

In any servo system there is a constant compromise between speed of response, accuracy, and stability. No one characteristic can be improved except at the expense of the others.

Also, manufacturing and cost problems make it difficult to adopt power steering to farm tractors. John Deere has apparently developed a workable system. Here are some specifications:

Steering spindle torque: 16,300 lb-in.
Steering rate: 43 deg per sec (on spindle)
600 deg per sec (on steering wheel)
Steering ratio: 14 to 1
Steering effort: 4 to 5 lb constant force

Power steering for tractors grew out of a definite need. The use of larger, front mounted implements adds weight to the front wheels and makes it difficult to steer. And the implement's ground reaction in the working position hampers steering control. Now power steering will permit heavier front mounted implements.

Also power steering reduces steering effort. This results in less operator fatigue and higher productivity. It also permits women and children to drive a tractor, and allows the operator to steer with one hand. Thus, the other hand is free to operate other controls.

The John Deere power steering system can be adapted easily to various row crop tractors using single, double, or wide spaced front wheels. (Paper on which this abridgment is based is available in full in multilithographed form from SAE Special Publications Department. Price: 35¢ to members, 60¢ to nonmembers.)

Based on Discussion

H. E. Hruska, Bendix Aviation Corp.

Steering wheel recovery or "centering" can be attained by hydraulic reaction or by a centering spring, depending upon valve design, operating conditions, type of vehicle, and the amount of friction in the system.

Hydraulic centering force is limited by the inherent design of the system. A centering spring transmits the full centering force to the wheels. However, an hydraulic balanced valve is less likely to flutter, and shock loads can be damped hydraulically regardless of their magnitude.

We have found that excessive oil flow in vehicles with high gear ratios create heat problems. Were you ever confronted with a similar problem?

C. Hess: No, not in this system. The reasons probably are the large oil capacity (4 to 5 qt) and the location of the reservoir in the front of the radiator in the air stream.

S. C. Heth, J. I. Case Co.

The ease of operating power steering sometimes leads operators to over control so that wheels plow rather than guide. Is the best solution increasing the driver's skill, a visible wheel-angle indicator, or a corrective mechanism actuated by wheel side loading?

C. Hess: To date the problem doesn't exist. Few implements so completely conceal the front wheels that the operator can't observe the angle of the wheels.

S. C. Heth: Is a mechanical centering device to return steering to straight ahead position desirable?

C. Hess: In this system there is enough reversibility to return the wheels to straight ahead, although not rapidly. We don't feel a special centering device is either necessary or particularly desirable.

R. D. Barret, International Harvester Co.

How can instability or flutter be overcome?

C. Hess: Instability is inherent in servo-mechanism systems. The amount of inertia, valve characteristics, speed of response, and the overall linkage all enter into this problem. Each system therefore must be considered individually.

Engine Noise

Is Closely Related to

Abnormal Combustion

Robert Meagher, R. L. Johnson, and K. G. Parthemore,

E. I. du Pont de Nemours & Co., Inc.

Excerpts from paper, "Correlation of Engine Noises with Combustion Phenomena," presented at SAE Summer Meeting, Atlantic City, June 10, 1954. This paper will be published in full in the 1955 SAE Transactions.

THE search for a more rational explanation of the noises accompanying abnormal combustion has revealed the following information:

1. In the absence of combustion-chamber deposits, engine noise was the result of knock following normal combustion initiated by a normal spark. There was no evidence of any significant preignition, postignition, or other unusual ignition.

2. After deposits had been accumulated in the laboratory engine under light-duty cyclic conditions, it was found that, with fuels closely satisfying the requirements of the engine, virtually every instance of fuel failure resulting in engine noise was the result of surface ignition, which led to knock. In no case did the *dp/dt* pattern of knock as obtained in the clean engine appear after deposits were accumulated. There were some differences in this respect between the data obtained in the laboratory and the data obtained in the car because of differences in the treatment to which the deposits were subjected while obtaining data.

3. There was no evidence of knock or other gas vibrations on the *dp/dt* records when rumble occurred. The diagrams indicated that rumble was a repetitive pattern of single or multiple surface ignition occurring immediately before or after spark. The noise probably resulted from deflections of some part of the engine structure induced by high rates of pressure rise. Rumble did not occur in the clean engine.

Apparatus and Procedures

A 9/1 compression ratio, overhead-valve V-8 engine on a dynamometer test stand was used to obtain most of the data. A *dp/dt* pickup was located in the combustion chamber of each cylinder. The rate of pressure change in all cylinders was indicated on two oscilloscope screens, the images appearing alternately on the screens in the same sequence as the firing order of the engine. These patterns were recorded photographically by means of a medium-speed, strip-film camera. Engine noises were observed on another oscilloscope screen, which displayed the output from a sensitive microphone placed close to the engine. This latter signal was photographed simultaneously with the rate of pressure change patterns.

Additional data were obtained employing a similar photographic procedure in a car containing the same type of 8-cyl engine. In the car, however, the *dp/dt* pickups were installed only on the right bank of the engine because the steering column interfered

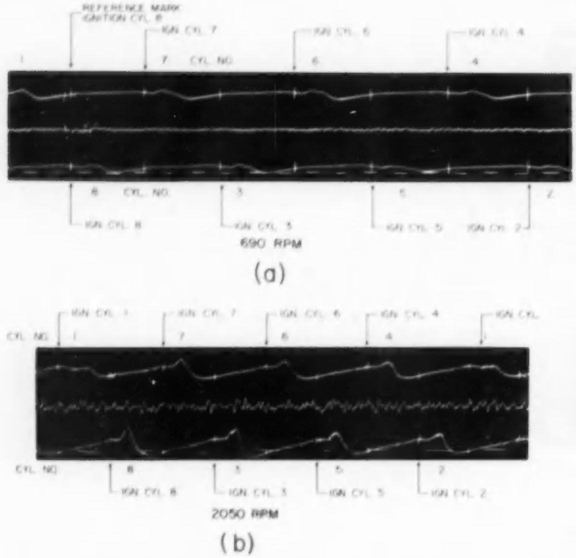


Fig. 1—Typical *dp/dt* and sound records during normal combustion in clean engine, with standard spark timing, using 92-octane leaded primary reference fuel: (a) low engine speed; (b) high engine speed

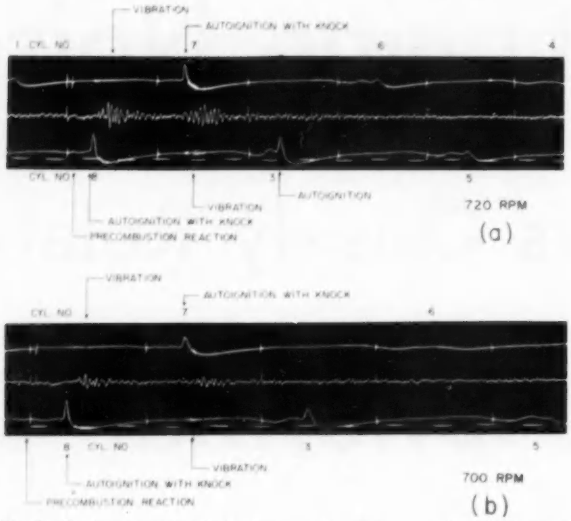


Fig. 2—Combustion records, in clean engine at low speed, with standard spark timing, using 88-octane leaded primary reference fuel: (a) autoignition in cylinder 3, autoignition with knock in cylinders 8 and 7, precombustion reaction after spark in cylinder 8; (b) autoignition with knock in cylinders 8 and 7, precombustion reaction before spark in cylinder 8

with the installation of the pickups on the left bank. The cylinders containing the *dp/dt* pickups were of 9/1 compression ratio, while the other cylinders had a compression ratio of 7.5/1. With this arrangement the pickups were in the cylinders that were critical from the noise standpoint. A microphone was not included in the car instrumentation. Engine noise was detected aurally and was correlated with the *dp/dt* traces by the observer in the car.

Records of the combustion patterns and engine noise during knocking and nonknocking combustion in the laboratory engine without deposits were obtained during a series of wide-open-throttle accelerations from approximately 700 to 2000 rpm. During these accelerations the engine was loaded so that the time required to accelerate through this speed range was approximately the same as would be required with the engine installed in the car on the road.

After the clean engine data were obtained, combustion-chamber deposits were accumulated in the engine by operating on a light-duty cyclic procedure for an extended period.

Combustion and noise patterns were obtained after 300 hr of deposit accumulation. Some additional data checks were also made after 375 and 400 hr of operation. The reference fuel systems used for rating the engine were of three types: (1) primary reference fuels containing 3 ml, tel per gal, (2) CRC severity reference fuels, which were unleaded, and (3) blends of full-boiling-range gasolines containing 3 ml, tel per gal.

Data were obtained in the road test car during a series of wide-open-throttle accelerations. The combustion chambers contained deposits that had been accumulated in approximately 3000 miles of low-duty operation with a fuel and lubricant similar to that used in the laboratory tests.

Combustion in a Clean Engine

In the particular 9/1 compression ratio engine used in these investigations and in the absence of combustion-chamber deposits, engine noise was the result of knock following normal combustion initiated by the normal spark discharge. There was no evidence of surface ignition. Fig. 1 shows typical rate of pressure change and sound patterns for normal combustion during an acceleration using a 92-octane-number leaded primary reference fuel and standard ignition timing in a clean laboratory engine. Variations in the *dp/dt* traces from cylinder to cylinder were slight and the shape of the *dp/dt* traces was not affected significantly by changes in the engine speed.

Knocking combustion was observed when fuel quality was lowered to 88 octane number. As shown in Fig. 2a, combustion in cylinders 6, 5, and 4 was normal, autoignition was occurring in cylinder 3 without apparent noise as indicated by the normal sound trace, while in cylinders 8 and 7 the autoignition was severe enough to produce a high-frequency noise, or knock, on the sound trace. Severe autoignition may induce sufficient vibration in some part or parts of the engine structure to record on the *dp/dt* pickups in cylinders other than the one in which autoignition occurred. Indications of such vibrations appear on the trace opposite that of the cylinder in which autoignition occurred. Examples of this are shown also in Figs. 2a and 2b.

It is important to note that, in the clean engine operated on 88- and 92-octane-number leaded primary reference fuels, there was no indication of

surface ignition or any other type of abnormal combustion other than autoignition.

It can be noted in Fig. 2 that a slight upward deflection in the rate of pressure change curve was present in cylinder 8 just after spark ignition in Fig. 2a and just before spark ignition in Fig. 2b. The trace did not continue to rise but paralleled the shape of the normal diagram. Because of the nature and condition of occurrence of this deflection, it is believed that it signals the presence of precombustion reactions. Although this phenomenon was readily observed when using 88-octane reference fuel, it was not evident with fuels of higher octane number.

Surface Ignition in Presence of Deposits

With combustion-chamber deposits present and using a fuel with an anti-knock value at or near the octane requirement of the engine, every instance of noise, or knock, was the result of surface ignition. The type of diagram obtained during knocking combustion in the clean engine was never observed in the engine with deposits present.

Fig. 3 shows the combustion patterns and the noise trace obtained during accelerations using a 108-performance-number leaded primary reference fuel. This fuel was determined to just satisfy the requirement of the engine containing deposits accumulated in 300 hr of light-duty cyclic operation. Under these conditions a majority of the cycles exhibited normal combustion patterns; however, in every cycle producing noise there was clearcut evidence of surface ignition. Most of the surface ignition was clearly preignition. As might be expected this ignition was erratic both in occurrence and in ignition advance. A combustion cycle is shown in which very early surface ignition occurred, resulting in a knock noise, and cycles where surface ignition occurred after the spark (termed postignition).

At higher engine speeds there often occurred a low-frequency, continuous noise, which has been termed rumble. A combustion diagram for this phenomenon is illustrated in Fig. 3b. This noise is not the result of autoignition and gas vibrations, but rather a vibration of some part of the engine structure induced by high rates of pressure rise occurring immediately before or after spark. The cause of the rapid pressure rise appears to be a multiple surface ignition of the charge, which occurs at or near the time of normal spark ignition. As shown by the sound trace of Fig. 3b, the noise occurs at about 30 deg after spark ignition. Note that there is a complete absence of gas vibrations on the dp/dt record. Rumble usually occurs at speeds higher than 1400 rpm. It does not occur in the clean engine. Rumble was disregarded in establishing the fuel requirement of the engine.

Examination of the photographic records taken under the conditions just described showed several instances of isolated, violent knocking brought about by preignition. It is believed that this is the phenomenon that has been termed "wild ping."

Road Tests—Unlike the results obtained in the laboratory engine, knock in the road test car in the presence of deposits was not positively indicated as resulting from surface ignition. Nevertheless, from careful study of the data, it is believed that surface

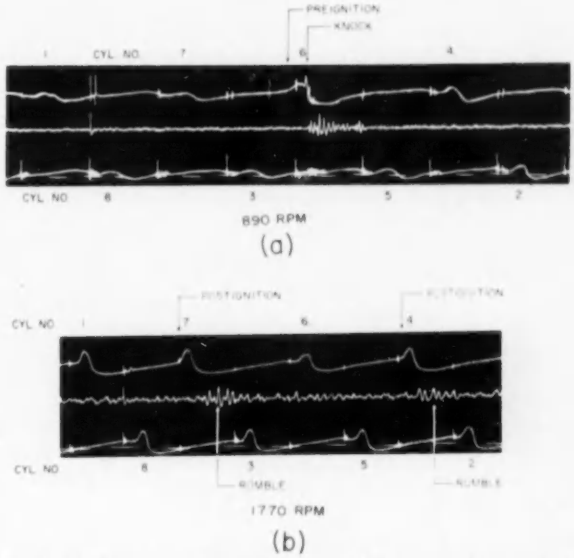


Fig. 3—Combustion records, in engine with deposits, with standard spark timing, using 108-performance-number leaded primary reference fuel: (a) low engine speed showing knock resulting from preignition in cylinder 6; (b) high engine speed showing postignition in cylinders 7 and 4 producing rumble

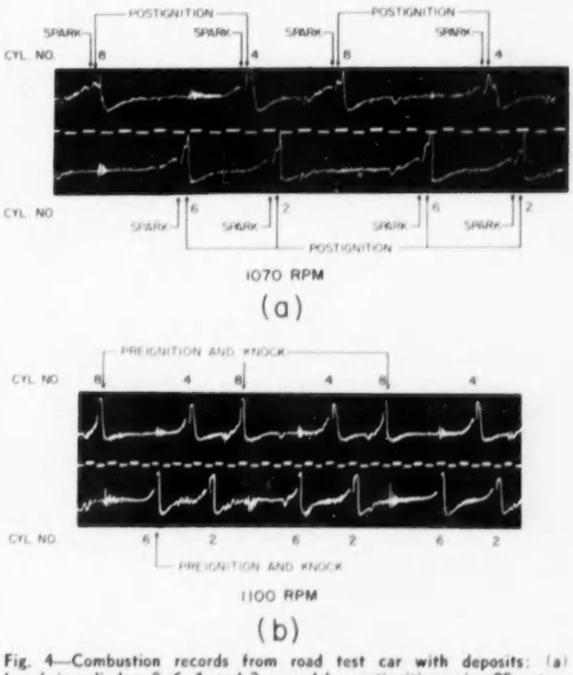


Fig. 4—Combustion records from road test car with deposits: (a) knock in cylinders 8, 6, 4, and 2 caused by postignition using 90-octane leaded primary reference fuel, with standard spark advance; (b) knock resulting from preignition in cylinders 6 and 8 using 96-octane leaded primary reference fuel, with spark advanced 1½ deg from standard

ignition did occur during the majority of the cycles that gave knock. However, such surface ignition took place after spark ignition, while in the laboratory engine the surface ignition usually occurred before the spark. It is believed that any discrepancy between the laboratory engine and the car on the road was due to the different type of deposits in the combustion chambers. While both the laboratory and car engine deposits were accumulated under mild-duty conditions, with the laboratory engine each small series of accelerations was made with freshly accumulated deposits. On the road the deposit condition deteriorated as a result of the frequency of accelerations.

Fig. 4 shows several dp/dt records obtained in the car. The dp/dt records for cylinders 4 and 8 are shown in each case on the upper trace—the records for cylinders 6 and 2 are indicated on the lower trace. Spark discharge is indicated by a gap in the dp/dt trace. There is no sound trace on this figure, and the dashed line in the middle is the timing mark trace.

Fig. 4a shows autoignition in all cylinders (numbers 8, 6, 4, and 2) with standard spark advance using 90-octane-number leaded primary reference fuel. That audible knock occurred is indicated by the vibration type of patterns on the trace opposite the knocking cylinders. Fig. 4b shows severe preignition followed by knock in cylinders 6 and 8, with the spark advanced $1\frac{1}{2}$ deg from standard, using 96-octane-number leaded primary reference fuel.

It is evident from these data that every instance of noise in the laboratory engine with deposits was the result of surface ignition. The fact that this might not always be so with the car on the road points up the importance of the nature of deposits on the type of fuel failure.

On the basis of the work done to date it is believed that in engines of 9/1 compression ratio operated under average driving conditions, surface-ignition-induced knock may account for a majority of the engine noise.

(Paper on which this abridgment is based is available in full in photooffset form from SAE Special Publications Department. Price: 35¢ to members, 60¢ to nonmembers.)

Breaking Through the Heat Barrier . . .

. . . awaits new developments in heat-resistant metallic and non-metallic materials.

Based on field editor's report by

W. E. Achor, Thompson Products Inc.

This article is an abridgment of the field editor's report of the Seminar "High Temperature Materials for High Speed Aircraft" which met December 6-8, 1954 in Los Angeles.

Seminar Chairman

W. J. Lamorey Northrop Aircraft, Inc.

Assistant Chairman

T. M. Epperson Douglas Aircraft Co.

Moderators

W. M. Steffen, Northrop Aircraft, Inc.

F. R. Kostoch, North American Aviation, Inc.

F. S. Boericke, Haynes-Stellite Co.

THE current search for materials to withstand the high temperatures incurred during super-sonic flight goes forward in two directions: toward metallic materials and toward non-metallic materials. Sometimes a combination of both is required to give the necessary strength and temperature properties. Often a specific problem can be only partially solved because so little is known about the physical properties of the various materials at high temperatures. But new knowledge is being uncovered daily, which will contribute to progress in both directions.

In the non-metallic field—

There are uses on high speed aircraft where only the properties of non-metallics will serve. In the desire to substitute non-metallic material for stainless steel air ducting, much experimentation has been done with glass fabric-plastic resin panels and ducts, both alone and in combination with various metallic surfaces or interlayers. The materials were subjected to 2000 F flame for periods up to 15 min-

utes. The tests indicate that only silicon laminates show promise of meeting high temperature requirements.

The heat distortion temperatures of plastic materials being used for transparent enclosures of high-speed aircraft have been raised from 160 F to 275 F in comparatively few years. Continued progress is anticipated. Three factors must be reckoned with if plastics are to be used: (1) Optical problems caused by slanting windshields, (2) Temperature resistance caused by frictional heating, (3) Increased loads created by high altitude.

The materials presently available are classed as Acrylics, Polyesters, Modified Acrylics and Glass. These materials may be laminated, but the properties of the interlayer materials then become the limiting factor.

Due to the organic nature of rubber, severe problems are encountered at high temperatures. Until a suitable substitute is found, rubber and rubber-like materials may limit the performance of future aircraft.

In the metallic field—

Alloys available at the present time have many limitations. Magnesium and aluminum alloys lose strength rapidly at temperatures over 300 F. Heat treatable steels lose strength rapidly in the 300–500 F range, even though at room temperature they have specific strength as high as 900 to 925. Titanium alloys hold up in strength very well until they reach 800 or 900 F. Precipitation hardened iron base alloys fall off in strength fairly rapidly above 1000 F. The same is true of work hardened iron base alloys such as half-hard 302 stainless. Nickel base alloys of the age hardenable variety behave in a manner similar to the Inconel X, which begins to lose strength in the 1000 to 1200 F temperature range. Cobalt base alloys, work-hardened, maintain their strength at the highest temperature range.

The expanded use of heavy metals is a trend which will continue in the future.

There will be increased use of roll forging as a means of producing blanks for compression blades and turbine buckets. Nickel based turbine bucket alloys are susceptible to superficial surface, intergranular attack, during the forging and heat treating. It is essential to remove this surface by electrolytic acid pickling. Even grinding operations are sufficient to induce cold working of the surface which must also be removed by an electrolytic pickle. Failure to remove this metal results in a layer of recrystallization which could promote premature failure.

Since as little as ¼ of 1% creep deformation in wing materials will seriously affect aerodynamic properties the alloy 17-7PH will be getting increased attention in aircraft construction.

It is possible for a designer to use a base material and protect it from oxidation and corrosion attack by aluminizing the metal surfaces.

Short life missile units, such as ram jets, afterburners, and rockets are going to be requiring more and more attention from the materials engineers. With operating temperatures running as high as 2200 F for internal aircraft parts, Cermets will be the next step in protective coatings.

In addition to this news report, later issues of SAE Journal will carry feature articles based on these 12 technical papers which were presented at the seminar:

M. R. Kinsler, North American Aviation, Inc.
"The Aerodynamic and Power Plant Heating Problem in High Speed Aircraft."

C. S. Davis, Northrop Aircraft, Inc.
"Thermal Limitation of Common Aircraft Materials"

C. W. Alesch,
Convair Division, General Dynamics Corp.
"Some Trends in Elevated Temperature Resistant Aircraft Materials"

S. G. Demirjian, General Electric Co.
"Technological Advancements in Jet Engine Materials"

T. L. Burton, Douglas Aircraft Co.
"Hot Sandwiches-Honeycomb and Sandwich Structure"

B. L. Manire, Northrop Aircraft, Inc.
"Transparent Enclosure Materials"

F. E. Clark, North American Aviation, Inc.
"High Temperature Problems Associated With The Use of Rubber Parts in Aircraft"

L. O. Curtis, Douglas Aircraft Co.
"Open Flame Testing of Various Fiberglass Laminated Air Ducts at 2000 F"

M. Tiktinsky, Lockheed Aircraft Corp.
"The Selection of Metals for Airframe Components as Affected by Operating at Elevated Temperatures Up to 600 F"

J. W. Huffman, North American Aviation, Inc.
"Application of Metallic Materials for Aircraft Structures in the Temperature Range 600-1100 F"

A. V. Levy, Marquardt Aircraft Co.
"Application of Metals for Power Plants in the Temperature Range 1100-2400 F"

J. V. Long, Solar Aircraft Co.
"Ceramic and Metal Protective Coatings for High Temperature Materials"

A Special Publication, SP-128, compiled of the above 12 papers, is available from the SAE Special Publications Department, 29 West 39th Street, New York 18, N. Y. Price: $3.50 to members; $7.00 to nonmembers.

2–Engine 2–Level Bus: Result of

THERE'S 40 years of experience and engineering between the Hupmobile which ran the first commercial bus route (connecting Alice and Hibbing, Minnesota) and the new two-level Scenicruiser.

Fig. 1—Thirty-three passengers on the upper deck ride above the level of passing traffic. The lower deck, seating ten, is used for short-haul passengers

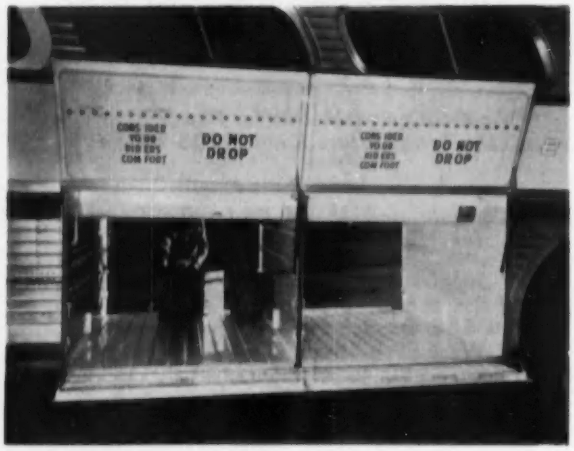


Fig. 2—Total baggage capacity is 375 cu ft

Power steering and power brakes control the 43 passenger, three-axle Scenicruiser. A 7½ ton air-conditioning unit maintains 76-78 deg temperature even in the extreme heat of the desert. Passengers have unrestricted vision through glareproof safety glass picture windows and sky lights.

The overall length of the 30,000 lb Scenicruiser is 40 ft. The cutaway profile in Fig. 1 shows the seating layout for 33 passengers on the upper deck, 10 on the lower deck. A lavatory, which operates chemically similar to the toilets on airplanes, is located at the stairway. Wash basin water is disposed of through the engine exhaust system.

Fig. 2 shows the tremendous size of the two main baggage compartments. These and other smaller compartments more than double the baggage capacity of previous buses.

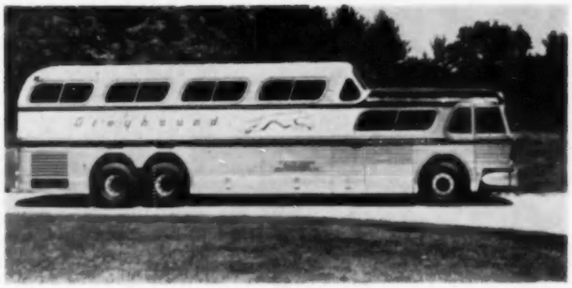
The entire body of the coach is floated on compressed air as shown in Fig. 3. The compressed air is metered to 12 flexible rubber nylon bellows, two to each wheel, which absorb vibration and road shock. The coach body is held constantly level on curves by automatic valves which control the air pressure.

Two General Motors, two-cycle, 150 hp diesel engines power the bus and the air-conditioning compressor. They are both complete engines and independent of each other as shown in Fig. 4. In emergencies either engine can propel the bus satisfactorily.

Through fluid couplings the two engines drive a common gear train which is connected to a single transmission.

An alternator is driven from the gear train so that current is supplied at all times whether one or both engines are in use. The air-conditioning compressor is driven by the right hand engine instead of the usual auxiliary gas engine.

The transmission can be shifted to the conventional three forward and one reverse positions. But



1954

1914

40 Years Experience

Joseph M. Sills, The Greyhound Corporation

Based on paper "The Two Level Intercity Coach" presented at SAE National Transportation Meeting, Boston, Oct. 18, 1954.

a two speed clutch enables the driver to increase each gear position by one half. Thus, by flipping a small button on the gear shift lever the driver actually has a six speed transmission.

Special disconnect fittings and a special dolly permit the engines to be removed for servicing in a matter of minutes without even draining the radiators. Thus, a spare engine can be put into a bus during a routine stop and the coach can be kept in continuous service.

One hundred of the initial order of 500 Scenicruisers are already on the road. (Paper on which this abridgment is based is available in full in multilithographed form from SAE Special Publications Department. Price: 35¢ to members. 60¢ to nonmembers.)

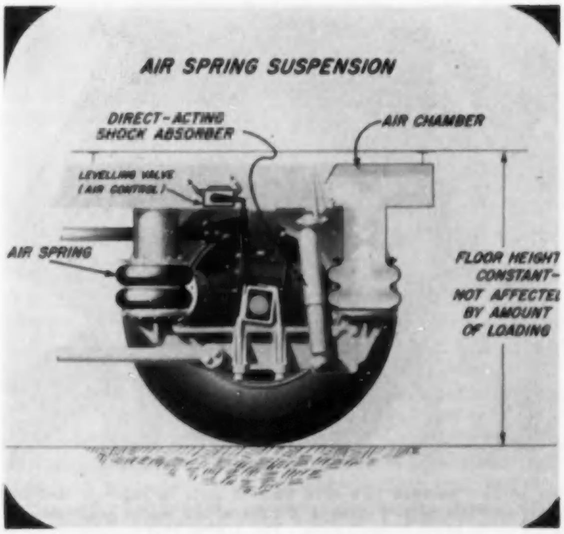


Fig. 3—Metal springs are eliminated by this suspension system which "floats" the body on compressed air

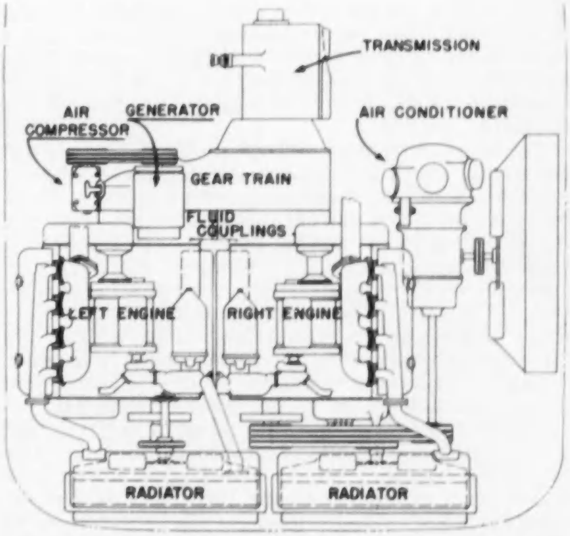
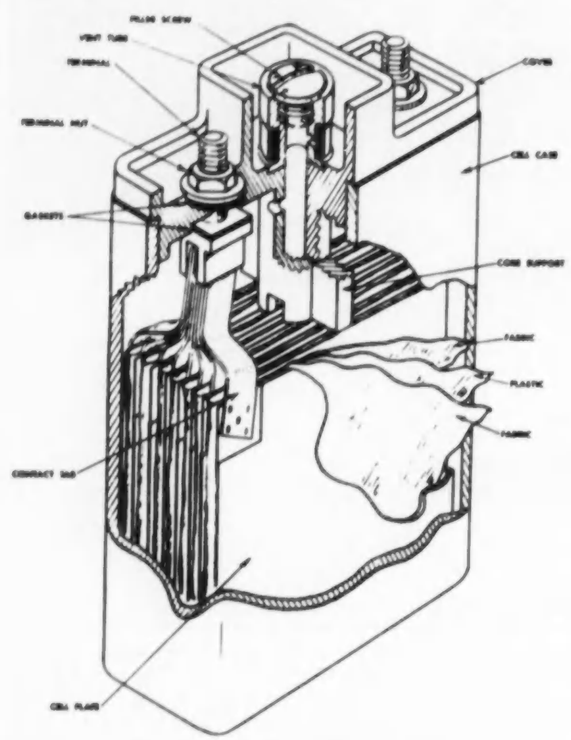


Fig. 4—Two 150 hp diesel engines are connected through fluid couplings which compensate for any slight differences in rpm between the engines



Sonotone Nickel-Cadmium Battery Cell

Inside the New

THE unique construction and chemistry of the nickel cadmium battery makes it adaptable to extreme climate and service conditions where ruggedness, high amperage, and long life are prime considerations. Here is explained its design and operation.

The most important innovation in the new nickel cadmium battery is its plates. Each plate is a screen of nickel wire that has been converted into a sheet by sintering nickel powder into its meshes. (Sintering is a process of making powder into a coherent mass by heating without melting.) Although the sheet is metal, it is relatively porous as shown in Fig. 1. Negative plates are made by electrochemically depositing cadmium hydroxide within the pores; positive plates by depositing nickel hydroxide.

Negative plates are welded to the negative terminal; positive plates to the positive terminal.

These plates have relatively smooth surfaces and can be packed very close together in the cell. The ions in the electrolyte have a very short distance to travel from one plate to the next, so internal resistance is low. Their closeness also contributes to the mechanical strength of the cells.

A multi-ply strip of flexible plastic and fabric

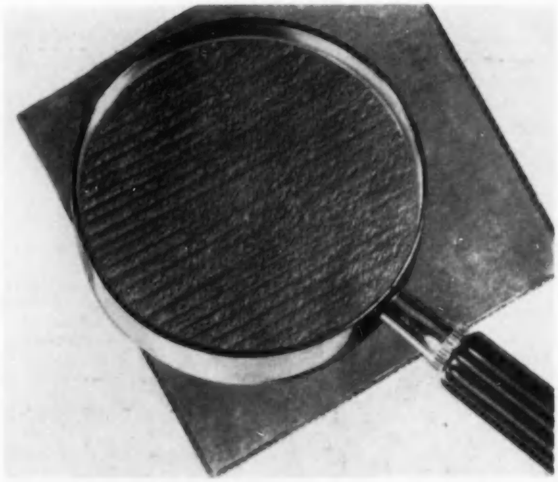


Fig. 1—This enlarged view of a sintered plate in the new Sonotone nickel-cadmium battery gives a glimpse of its porous structure, the secret of its power in small sizes. The cavities that serve as grids for the active nickel and cadmium deposits are microscopic, giving hundreds of square feet of working area in each plate

Nickel-Cadimum Battery

. . . this is how Sonotone's new nickel-cadimum battery works

L. G. Hector, Sonotone Corp

Based on paper "What the Nickel Cadmium Battery Can Do For Fleet Operators," presented at SAE National Transportation Meeting, Boston, Oct. 20, 1954

insulates each plate from the adjacent ones. This provides mechanical strength with minimum bulk, excellent electrical insulation, and the necessary electrolytic conduction when immersed in the electrolyte.

A 30%-by-weight solution of potassium hydroxide in distilled water is used as the electrolyte. During charge and discharge of the battery, no overall chemical change in the electrolyte takes place. Thus, there is no appreciable change in specific gravity as the cell charge changes. The specific gravity of the electrolyte at room temperature remains constant at 1.29. Lines on each cell indicate the level at which the electrolyte is to be kept.

Each cell consists of a transparent plastic case, housing a core assembly of positive and negative plates and separators. The E.M.F. of a cell at room temperature is approximately 1.30 v. A vent plug acts as a release valve for gases which may develop during charging and is a means of access for adding more electrolyte.

Cells are assembled into batteries housed in a steel case. A special baked-on paint which is not harmed by potassium hydroxide forms a strong bond to the steel and insulates the battery. The individual cells in the battery are replaceable.

How The Battery Operates

During charge—When charging current is applied to the battery, the cadmium-oxide active material of the negative plates gradually loses oxygen and becomes metallic cadmium. The nickel-oxide active material of the positive plates is brought to a higher state of oxidation. These changes in both sets of plates continue as long as the charging current is applied, or until the active materials of the plates have been completely converted. Toward the end of this process, and during any overcharge, the cell will gas. This is from the decomposition of the water in the electrolyte into hydrogen at the negative plates and oxygen at the positive plates. The electrolyte conducts the current between the positive and negative plates, where it reacts to pro-

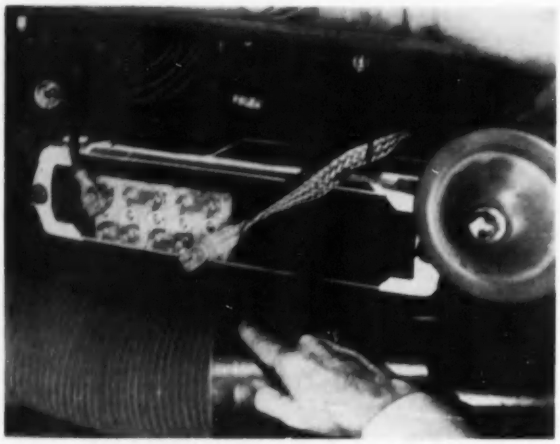


Fig. 2—Nickel-cadmium battery installed in a Buick Roadmaster shows the small fraction of the standard compartment occupied by the new battery

duce electrochemical changes. There is no significant change in the overall chemical composition of the electrolyte itself, or in its specific gravity.

During discharge—When a load is connected to the terminals of the battery, a reverse chemical action starts. The positive plates gradually return to a state of lower oxidation, and the negative plates gain back lost oxygen. The chemical energy of the plates is converted into electrical energy which is released as current flows through the load. The rate at which the chemical energy is converted depends on the resistance of the load to the flow of current. If the load offers no resistance, the discharge current is limited by the extremely low internal cell resistance and the negligible resistance of the battery leads and intercell connectors. The chemical nature of the electrolyte and its specific gravity remain unchanged during discharge. This contributes to the relatively constant voltage while the cell is discharging.

Battery Is Reliable and Versatile

The above construction and operating characteristics indicate that the nickel cadmium battery will have high performance standards under very critical conditions. Some of its outstanding attributes are as follows:

1. Tests equivalent to ten years' normal service show that the battery will last at least that long with no loss in capacity.

2. No damage to the battery will result from overcharging or reverse charging.

3. It is mechanically very rugged, and can be discharged in any position.

4. It may be stored, filled with electrolyte in either a charged or uncharged condition.

5. It can be charged at temperatures as low as −65 F and can operate at temperatures between −65 and +165 F.

6. It can supply fantastically high currents for its size. For example: 1,000 amp from a 30 amp-hr battery.

7. It can hold its charge for long periods. More than 60% of full charge will remain at the end of a year's storage at room temperature; 80 to 90% if stored at freezing temperatures.

8. It is smaller than a standard nickel-iron battery. (See Fig. 2.)

(Paper on which this abridgment is based is available in full in multilithographed form from SAE Special Publications Department. Price: 35¢ to members, 60¢ to nonmembers.)

Based on Discussion

In reply to questions during the discussion period, Mr. Hector brought out the following information:

1. Life expectancy can only be estimated. After over 3000 cycles of charging and discharging in a laboratory test, there was no evidence of damage. Eventually perhaps the positive grids might disintegrate first.

2. The weight of the nickel-cadmium battery is similar to that of a lead-acid battery for equal watt hours. But, since the new nickel-cadmium battery can provide such high current in proportion to its ampere hour rating, smaller batteries can be used in practically all installations. For example, a nickel-cadmium battery for use in a commercial vehicle is approximately 50% lighter and smaller than a comparable lead-acid battery. Where service is for engine starting only, a nickel-cadmium battery one fourth the size of a lead battery is adequate.

3. The initial cost of the new sintered-plate nickel-cadmium battery is high and, therefore, its use is not justified on a straight economy basis for most passenger cars. It will however, be used for service where reliability of performance is important and by people who operate their cars in extreme hot and cold weather.

4. In any type of heavy-duty service, such as taxis and commercial vehicles, where the life of standard batteries is short, economy favors the new nickel-cadmium battery, both for length of life and for reduction in down time.

5. The battery is also valuable for powering trucks and machinery in mines and for all forms of electrically powered vehicles where simple maintenance and rapid recharging are advantageous.

Ice Can Clog Carburetors . . .

. . . even in warm weather!

W. P. Dugan, Sun Oil Company and
H. A. Toulmin, Ethyl Corporation

Based on paper "The Carburetor Icing Tendencies of Some Present Day Fuels and Engines," presented at SAE Summer Meeting, Atlantic City, June 11, 1954

IT doesn't have to be below freezing for ice to form in a carburetor and stall the engine. Whether it does or not depends upon (1) the volatility of the fuel, (2) engine design, (3) weather, and (4) operating conditions. This is what happens:

Ice Cuts Off Air To Engine

As fuel evaporates in the carburetor, it removes heat from the throttle blade and carburetor barrel. If the ambient temperature is low enough, and if the fuel is sufficiently volatile, their temperatures are quickly lowered below freezing. Any moisture in the incoming air that comes in contact with these parts immediately begins to form a coating of ice.

Eventually the entire top and edges of the throttle blade are coated as in Fig. 1. This restricts air flow past the blade until engine speed is reduced to the stalling point. The amount of icing, and therefore stalling, varies with the following:

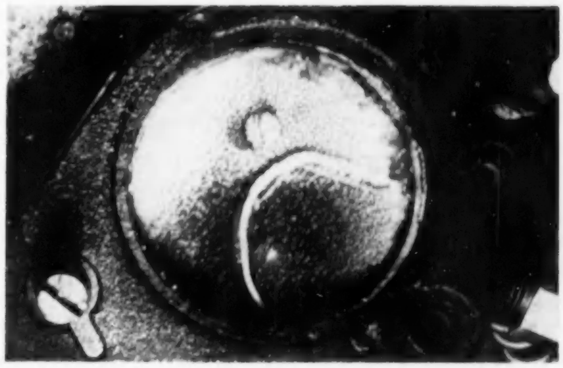


Fig. 1—Ice forms on the throttle blade due to evaporation of high volatile fuel. The snake-like object in the picture is a thermocouple wire used in measuring throttle blade temperature.

1. Fuel Volatility

High volatile fuels cause icing and stalling in some engines. In others, the effect is quite small. Six different 1953 engines were tested using fuels of high, average, and low volatility. As shown in Fig. 2, not only are there differences between the icing tendencies of fuels, but there are also differences between the manner in which different engines are affected by fuel volatility.

Engines B, C, and D show a considerable reduction in stalling tendency as volatility is decreased. But the other engines, especially E, are only slightly affected by volatility.

Further tests found that certain portions of the fuel boiling range affect stalling more than other portions. As 10% point is increased, stalling tendency decreases. Changes in 50% point decreases stalling even more, but changes in 90% evaporated point have only slight effect.

Since high volatility, particularly in the mid-boiling range, results in engine stalling, one way of solving the problem is to make fuels of lower volatility. But this would introduce new performance problems such as hindering starting ability and en-

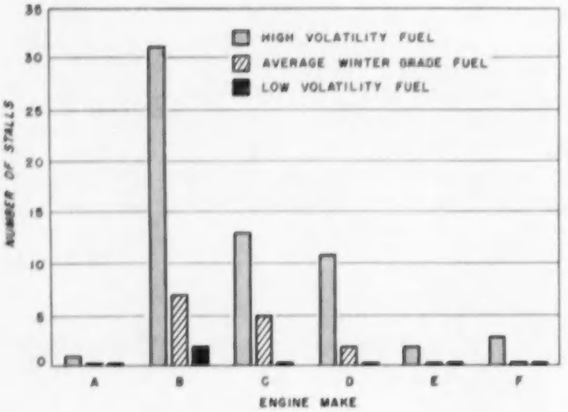


Fig. 2—Changes in fuel volatility cause stalling due to icing in engines B, C, and D. In other engines the effect is quite small.

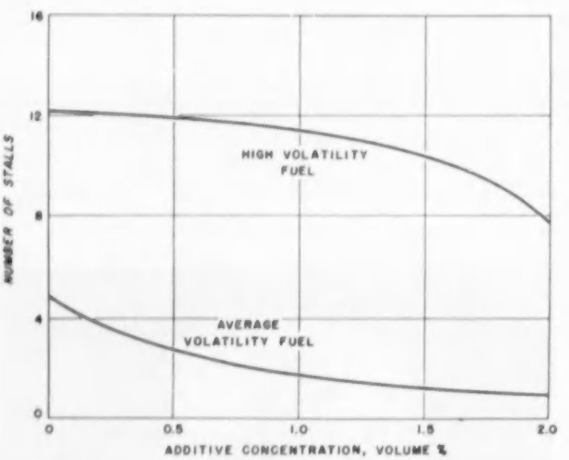


Fig. 3—High concentrations of anti-stalling fuel additive are equally effective in reducing stalls in both high and average volatility fuel. Ambient temperature is 40 deg F, 100% relative humidity.

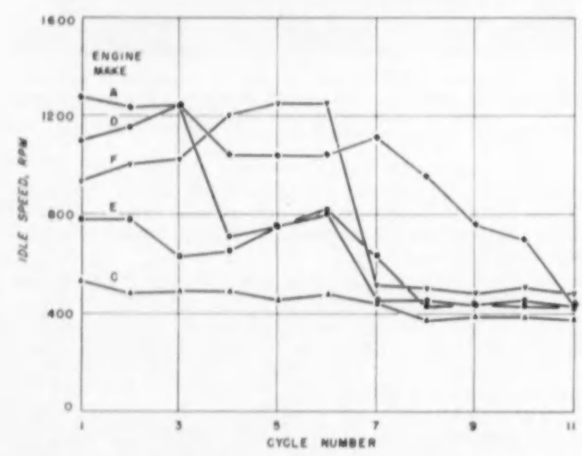


Fig. 4—Fast idle speeds, maintained over a long period of time, will usually reduce stalling due to icing. A non-stalling, low volatile fuel was used during this test. 40 deg F ambient temperature.

gine warm-up. It would also increase the amount of crankcase oil dilution. A better solution is to use a suitable anti-icing additive.

For example, concentrations between 0.5 and 2% of additive were mixed in an average volatility fuel and an extremely volatile fuel. Fig. 3 shows that at the lower concentrations the additive was most effective in the average volatility fuel. On the other hand, low concentrations had little effect on the high volatility fuel. At the higher concentrations, the additive was equally effective in both type of fuels in reducing the number of stalls.

2. Engine Design

Two design items that affect carburetor icing and engine stalling are fast idle speed and throttle blade temperature.

Fast idle speed is the increased idle speed during the early part of the warm-up which is designed to prevent the cold engine from slowing down and stalling.

The fast idle speeds of five of the engines, using non-stalling fuel, are compared in Fig. 4. Engine A, which showed excellent anti-stalling characteristics, has the highest overall fast idle speed. And it's maintained over a long period of time. This is an advantage since stalling does not usually occur in the first few minutes of operation.

Engine C, which gave poor anti-stalling performance, had a very low fast idle speed.

The fast idle system of engine D appears to go out of action rather quickly. This partially accounts for its poor anti-stalling characteristics.

Engine E, which had good anti-stalling characteristics is usually installed with an automatic transmission. Because of this, it is necessary to maintain rather low fast idle speeds. Therefore, to avoid stalling, the carburetor throttle body of this engine is heated during the warm-up period.

Engine F also showed good anti-stalling properties. It has a rather high fast idle speed, although it is brought to normal quite soon. Perhaps the fact that it has an aluminum carburetor throttle body,

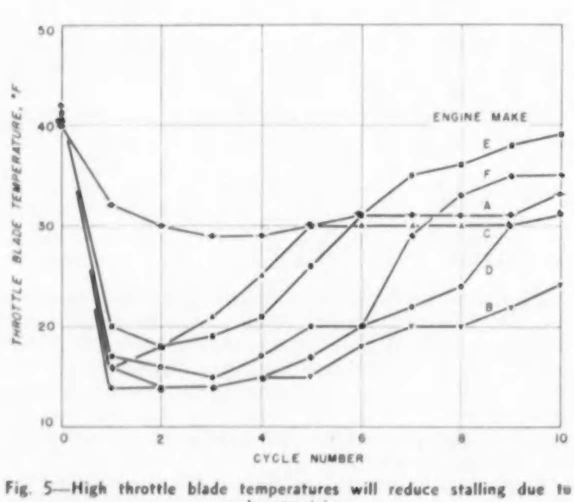


Fig. 5—High throttle blade temperatures will reduce stalling due to carburetor icing.

which transmits heat easily, accounts for its good performance.

Throttle blade temperature also appears to account partially for differences in anti-stalling between engines. Fig. 5 shows that engines E, F, and A, all of which gave good anti-stalling performances, increase throttle blade temperature rapidly after the initial drop.

Two of the stalling engines, B and D, had the lowest overall throttle blade temperatures.

Engine E has a carburetor heater. Fig. 6 shows the difference in throttle blade temperature between heat on and heat off. Stalls were reduced from six to two when heat was added.

Throttle blade temperature is a direct effect of fuel volatility. As would be expected, Fig. 7 shows that the high volatile fuels give the greatest temperature drop.

From the above discussion it can be seen that high fast idle speed tends to keep the engine from slowing down enough to stall, and high throttle temperatures minimize the amount of ice formed.

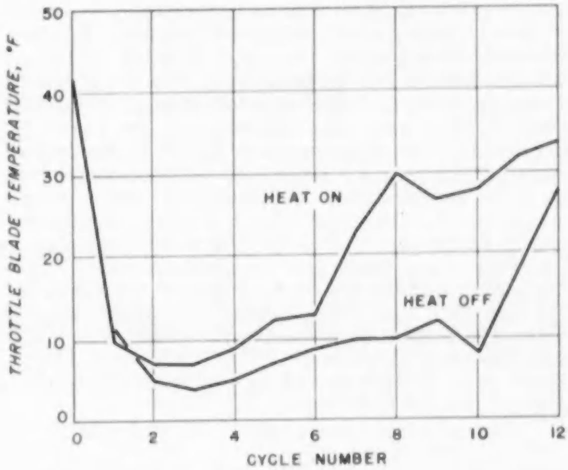


Fig. 6—A carburetor heater will increase throttle blade temperature during the critical icing period.

3. Weather

Atmospheric conditions most conducive to ice formation are around 40 deg F ambient with 100% relative humidity. Fig. 8 shows that with a fairly volatile fuel, stalling due to ice clogging, should cease below about 30 deg F and above about 50 deg F. With a fuel of average volatility the temperature range is slightly narrower.

Stalling ceases below 65% relative humidity for high volatile fuels and below 75% for average volatile fuels.

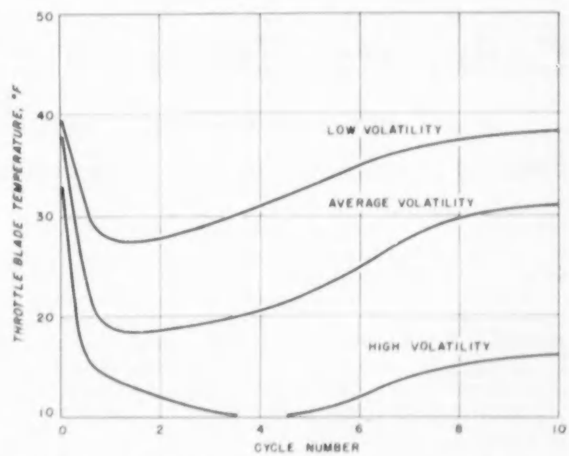


Fig. 7—High volatile fuels reduce throttle blade temperature much more than average or low volatile fuels. This data represents an average of six engines.

4. Operating Conditions

Stalling due to ice formation is most likely to occur during idling, when the throttle blade is almost entirely closed. After an engine has been driven about 15 minutes without idling, there is sufficient heat to prevent ice formation and subsequent stalling.

Fortunately, a number of conditions must occur at the same time before ice can form on a carburetor and actually stall an engine. We have seen how changing some or all of these conditions will eliminate this type of stalling. However, improving anti-stalling performance must be carefully weighed against cost and creating other performance problems.

(Paper on which this abridgment is based is available in full in multilithographed form from SAE Special Publications Department. Price: 35¢ to members, 60¢ to nonmembers.)

Based on Discussion

Al Cleveland, Ford Motor Co.

The results confirm our previous feeling that stalling due to ice forming in the carburetor can be corrected best by engine design.

It is surprising that carburetor icing is much affected by 50% point.

Harry A. Collins, Research Laboratories, General Motors Corp.

Carburetor icing happens under an extremely broad range of ambient air conditions. In Alaska, icing

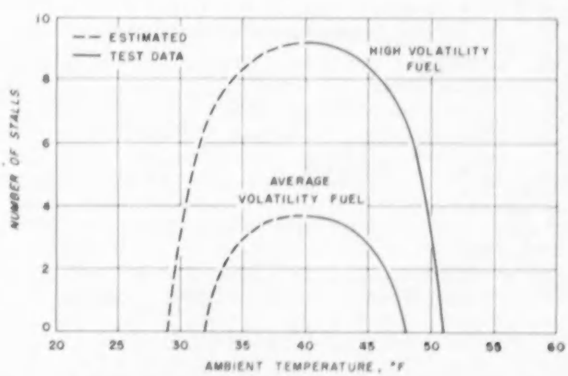


Fig. 8—Stalling due to icing is greatest at about 40 deg F ambient for both high and average volatile fuels.

is quite common in an ambient of − 60 deg F. during ice fogs. At this temperature the fog has a relative humidity of 80 to 85%. Actually a vehicle engine in this territory is heated to at least − 20 deg F before it can be started. Even then, stalling is of greater duration than anywhere else in the world.

In the lowlands, near bodies of water or marshland icing occurs almost regardless of the season or ambient temperature. In cities, stop-start driving means more periods of closed throttle and slower engine warm-up. This is conducive to icing.

Contrary to the findings of this report, I have found that engines of the greatest cubic inch displacement suffered the most from carburetor icing. This is relative because more moisture laden air passes over the throttle blade.

There seem to be two avenues of research open to combat icing:

(1) The use of alcohol additives in the fuel which would cut icing but also reduce fuel volatility.

(2) The use of an aluminum lower carburetor body which would transmit exhaust heat during warm-up.

J. F. Kunc, Jr.

Esso Laboratories Research Division, Standard Oil Development Co.

Most of the mechanical schemes which have been proposed to prevent carburetor icing involve bringing additional heat to the carburetor to keep temperatures above freezing. But this may sacrifice resistance to vapor locking.

Serious icing difficulties have been reported in several small English cars.

Sometimes carburetor ice can form so that the throttle is stuck in an open position. This is extremely more dangerous than stalling.

Carburetor Gumming . . .

. . . of late model cars in city driving becomes serious problem. Blowby found to be principal cause, best cured by using detergent gasoline.

Based on paper by **H. W. Sigworth and J. Q. Payne,** California Research Corp.

CARBURETOR gumming quickly results in rough idling, stalling, balky acceleration, and poor gasoline mileage. The deposit restricts the flow of air past the edge of the throttle plate at idle, enriching the mixture to the point where carburetor adjustment or clean-up becomes necessary. Fleet owners, particularly those who operate late model cars with multiple-throat carburetors in stop-and-go city driving, find gumming creates a serious maintenance problem.

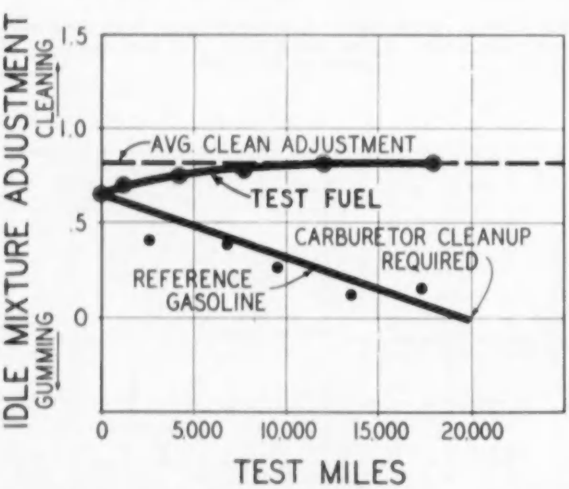


Fig. 1—This chart shows the rapidity with which carburetors in a group of taxis were cleaned up once the switch was made to detergent-action gasoline

Investigation reveals gumming to occur at idle because: (1) the closed throttle position sets up high velocities around the throttle plate edge, separating entrained material; (2) blowby concentration in the underhood atmosphere is at maximum; and (3) velocities through the air cleaner are apparently too low to separate contaminants.

Throttle plate-to-wall clearance is a factor influencing gumming. If larger clearances are used, more of the particular matter will be drawn past the plate edge without impingment on the throttle body. The converse is also true, which explains why the trend toward multiple-throat carburetion is increasing gumming tendency. With these modern carburetors, smaller clearance is needed for reasonably low idle speeds.

Blowby is the chief culprit. In normal service, an appreciable portion of the blowby finds its way into the air intake and contributes about one-half of the gum. The remainder can be credited to the exhaust gases of other vehicles, together with atmospheric dust and smoke, since some deposit still forms when inlet air is taken from outside the engine compart-

ment. Analysis of deposits shows 5 to 40% lead (present as lead halide and lead sulphate) with aluminum and silicon in small amounts, indicating the contribution of dust. Gum contained in gasoline will not predict carburetor gumming.

A special type of detergent properly imparted to the gasoline will remove deposits effectively from the throttle body and other parts of a carburetor. The detergent action is accomplished at speeds above idle when liquid gasoline discharged from the accelerator pump or high speed jet flows past the throttle plate. Gum still forms at idle, but is washed away on throttle opening.

Fig. 1 presents data which show the average clean-up of a group of taxicab carburetors operating on regular grade detergent gasoline. Idle mixture adjustment was used as an indication of the extent of gumming. Gumming was arrested and clean-up begun as soon as the change was made to detergent-action gasoline. (Paper, "The Cause and Correction of Carburetor Gumming" was presented at SAE National Fuels and Lubricants Meeting, Tulsa, Nov. 4, 1954. It is available in full in multilithographed form from SAE Special Publications Department. Price: 35¢ to members, 60¢ to nonmembers.)

Based on discussion . . .

E. W. Beckman,
Chrysler Corp.

Complaints of rough idle and engine stalling in the Los Angeles area led to laboratory engine tests to determine factors in deposit build-up. With the crankcase ventilating system so fixed that no blowby could enter the carburetor air cleaner, there was no loss of carburetor mixture adjustment after 50 hr of cyclic operation. After ring modification to increase blowby and thereby accelerate the test, all blowby was fed to the air cleaner and loss of mixture adjustment at the end of 50 hr was 60%.

When the same amount of blowby was fed the air cleaner in an atmosphere containing ozone at a concentration of 30 to 60 ppm, the loss of mixture adjustment was 100% at the end of 50 hr. The deposit formation appeared to duplicate that found in Los Angeles carburetors.

Ozone content of the Los Angeles atmosphere is relatively high. Its concentration (as much as 30 ppm) varies seasonally, being highest in summer and fall, periods when complaints reach their maximum.

E. F. Haigh and C. F. Arnold,
Cadillac Motor Division, General Motors Corp.

Trouble from throttle body deposits, particularly in the Los Angeles area, led us to develop an idle-air by-pass carburetor which proved so satisfactory that it was developed further and appears on the 1955 Cadillac.

It was reasoned that if the large periphery-to-area of the idle-air passages could be reduced, the effect of the total air flow at idle of small quantities of deposit on the walls of the idle-air passages also could be reduced. In the resulting idle-air by-pass carburetor the air required for idling comes from the carburetor venturi section. The idle air by-passes the throttle valve and is returned to the throttle bore below the valves. Part of the idle-air passes through a fixed opening and part through an opening fitted with an adjusting screw for controlling idle speed. Fuel is supplied through another adjustable opening.

W. G. Agnew,
General Motors Corp.

Using a single cylinder engine with triple manifold arrangement, runs were made in which ozone, nitric oxide, exhaust gas and blowby gases were added to the air entering one of the three manifolds. Ozone concentration was 0.3 to 0.4 ppm, nitric oxide between 0.2 and 20 ppm, and exhaust and blowby gases 0.1% by volume.

Neither exhaust nor blowby gases had any significant effect on manifold deposits. With ozone the deposit weight increased from 38 to 115% and averaged 68%, while the nitric oxide increased deposit weight from 76 to 426% with an average of 149%.

The Los Angeles smog is characterized by high ozone and nitric oxide concentrations, actually on the order of 0.2 to 0.4 ppm. Since deposit difficulties were reported greatly aggravated during the severe smog period, perhaps smog is an important contributor to the Los Angeles problem.

H. J. Gibson,
Ethyl Corp.

Throttle body deposits are not confined to the West Coast. During a Detroit test program with a fleet of high compression V-8 cars, losses in idle speed of as much as 150 rpm and average of 75 rpm were recorded after 3000 miles. After 6000 to 9000 miles, carburetors were set to best idle and to give standard idle speed, then the carburetor air horn was sprayed with a solvent while the engine was running. After this cleaning the idle mixture again was adjusted to best idle and engine speed recorded. The clean-up usually resulted in a 200 rpm increase in idle speed. These troubles occurred during August and September. With cooler weather the problem moderated and in January ceased altogether.

W. Kaplan,
American Refining Corp.

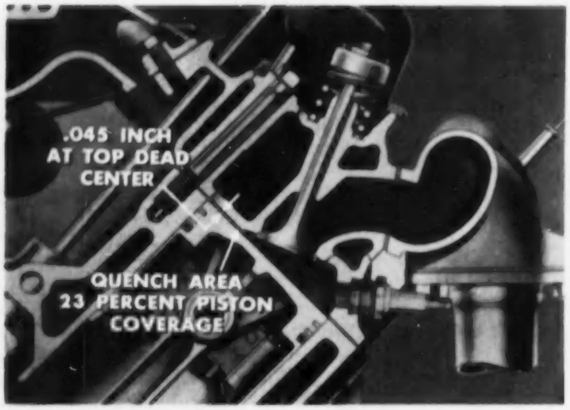
Complaint by a Baltimore taxicab company that gasoline mileage was falling off in about three weeks operation, despite replacement with rebuilt carburetors at four week intervals, launched an investigation which revealed small pyramids forming in the idle air passages. Tests which followed indicated the deposit to be due to air contamination. It was found that deposition increased rapidly when exhaust gases were introduced under the hood area.

In this instance relief was obtained by putting a small sheet metal hood over the idle-air passage to alter the direction of air entering the bleed idle passage and cause air borne dirt to be removed by inertia. In addition, a cover was placed over the air cleaner and a 14-mesh wire screen was inserted in the first passage to the oil bath.

Chevrolet's New V-8

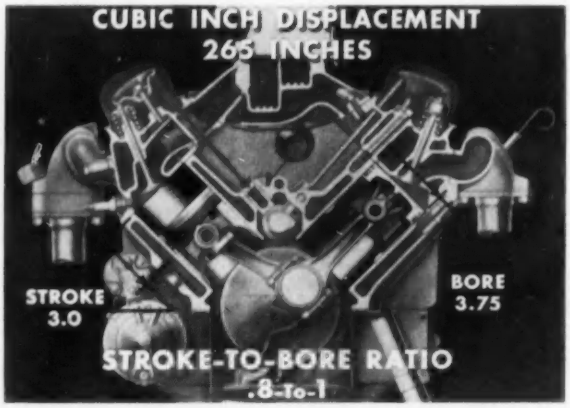
IN designing its 1955 V-8, one of Chevrolet's prime objectives was to make the engine as compact and as light weight as possible. The block, the lubrication system, the new valve operating mechanism, and the intake manifold is more simple, lighter, and easier to manufacture. Other engine components were also designed to give the smallest engine possible with greater displacement and horsepower.

Here is a brief description of the new V-8 engine:



Combustion chamber is wedge-shaped

A high turbulence wedge-type combustion chamber was designed for combustion control and combustion smoothness, since it controls the rate of pressure rise in the chamber. This type, which exposes a high volume of the charge early in the burn cycle and then goes out into a quench area, gives low octane requirement and smoothness of operation. It also permits the use of a flat top piston, which is more economical and reduces piston head mass.

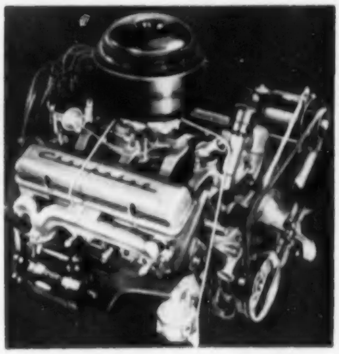


Compression ratio of 8 to 1

An 8 to 1 compression ratio was selected to get acceptable operation on regular grade fuels. In some areas the octane quality of the fuel is below what the engine requires. But in those areas, premium grade fuel can be used, or the spark retarded. Requirements when equipped with Powerglide transmission, are 85 to 90 octane number with 5000 to 25,000 miles of operation. Requirements with conventional transmission are 88 to 93 octane number.

Features

Compactness



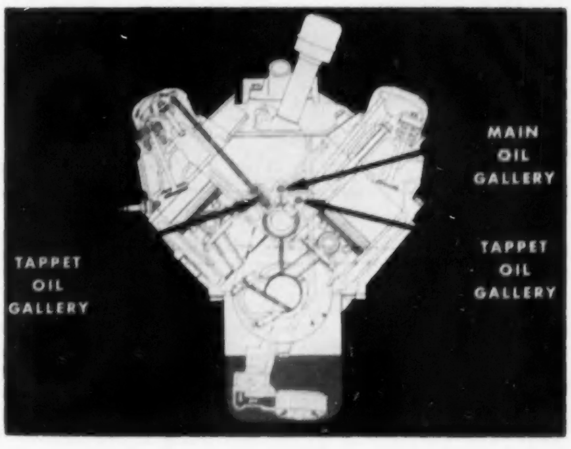
R. F. Sanders, Chevrolet Motors Div., General Motors Corp.

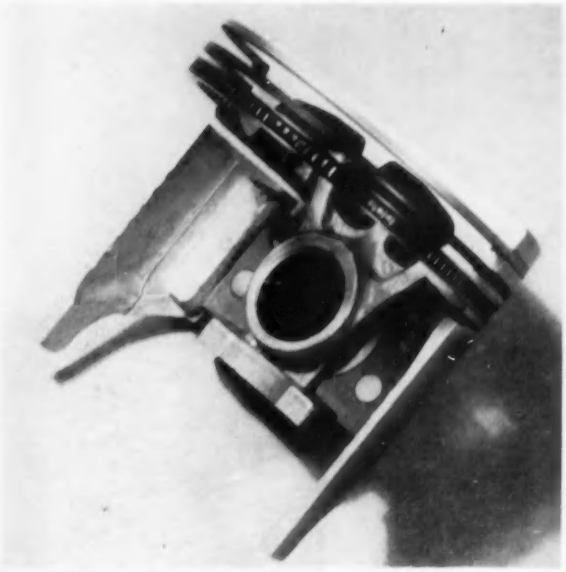
Based on paper "The New Chevrolet V-8 Engine," presented at SAE Golden Anniversary Annual Meeting, Detroit, January 12, 1955.

Lubrication system

All oil passages are drilled in the block; there are no drilled holes in the cylinder head for high pressure lubrication. Three holes, drilled horizontally in the block, provide the main and two tappet oil galleries. A drilled hole from the high pressure main oil gallery lines up with a small hole in the camshaft rear bearing shell, keeping high pressure oil on this bearing at all times, and through another hole to each of the tappet galleries. The pressure of the oil in the tappet galleries is controlled through the length of the metering slot milled in the camshaft journal. Oil flows out of the top of the tappets, through the hollow push rods, and lubricates the rocker arms and the valve stems.

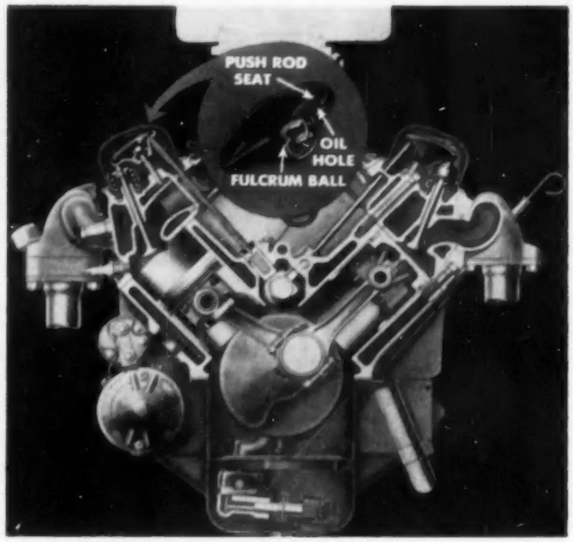
Oil holes in the connecting rod bearing caps at the spilt are so oriented that the right hand bank of rods lubricate the left bank cylinder walls and the left hand rods lubricate the right hand bank of cylinders.





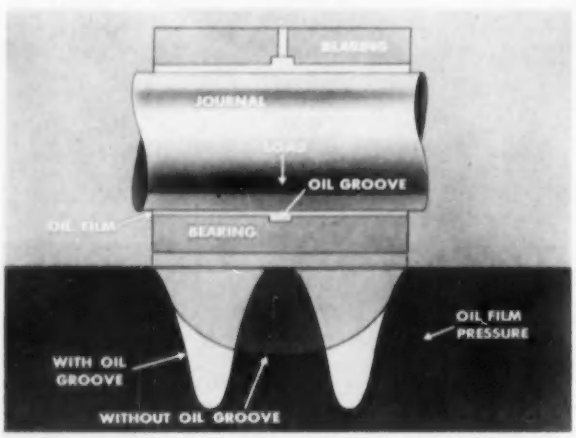
Autothermic piston has 3 piston rings

A steel insert slipper-type aluminum piston uses three piston rings. The two compression rings are thick wall alloy iron, the top ring is flash chrome plated and lapped to prevent scuffing during early engine operation. A new type of circumferential expander for the oil ring provides an axial force as well as a radial force to control oil pull-over.



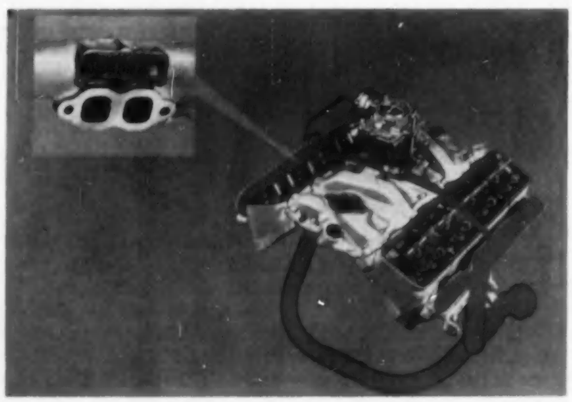
A new valve train

The valve train is the same as the new system developed by the Pontiac Motor Car Division. (See page 20) Each rocker arm is entirely independent of the others, and therefore deflection of one has no effect on any other. Each arm is assembled over a valve stem and push rod and retained by a fulcrum ball and lock nut. Valves are lashed by simply turning the nut, whether mechanical or hydraulic lifters are used.



Five main bearings are same diameter

The crankshaft thrust is taken by the rear bearing. All five bearings are the same size. Maximum loads are carried in the lower half. By reducing the maximum oil film loads through omission of the oil groove in the lower half, the capacity of the main bearings is increased approximately 100%, and wear is reduced.



Exhaust system

The exhaust system consists of three basic units: the left hand exhaust manifold, a cross-under pipe, and the right hand exhaust manifold. The external exhaust pipe crosses below the front of the engine. Since it is exposed to the air stream from the fan and the air movement under the vehicle, high temperature build-up under the hood is reduced. An automatic choke is standard equipment.

Intake manifold is simplified

The intake manifold casting not only acts as the fuel intake manifold, but also includes the following:

Provision for hot water heater take-off.

Cross-over for exhaust heat to the carburetor.

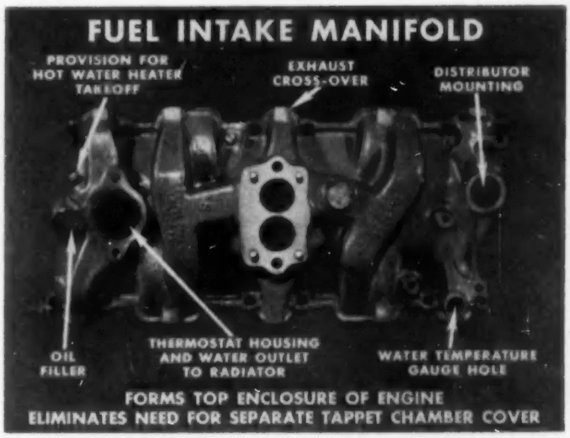
Distributor mounting.

Oil filter.

Thermostat housing.

Water outlet to the radiator.

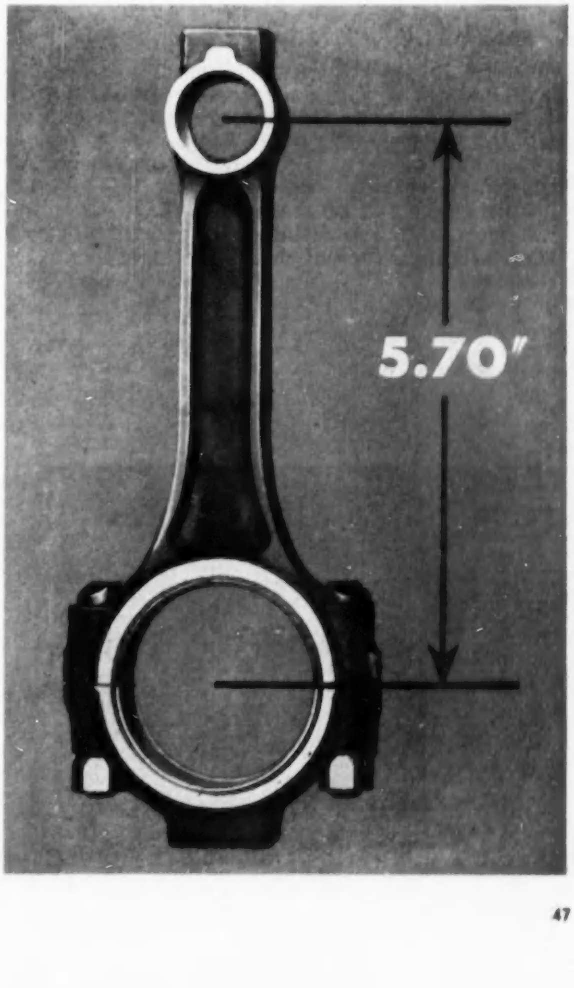
Water temperature gage hole.



It also forms the top enclosure of the engine and eliminates the need for a separate tappet chamber cover. It is very effective in suppressing noise, it adds considerable rigidity to the engine assembly, and it reduces assembly time. It also prevents the passage of cold air under the manifold which otherwise would reduce mixture temperatures during winter operation.

Connecting rods are short

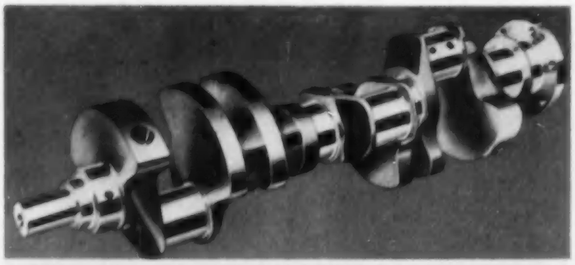
In spite of the large piston, the connecting rod column section and weight were kept low. Its short length maintains high structural rigidity. Center distance is only 5.70 in., and length to stroke ratio is 1.9. A pressed-in piston pin, which can withstand a load of 2000 to 3000 lb, eliminates the slitting of the rod and the need for a locking bolt, and relieves the great stress concentration of the clamping method.

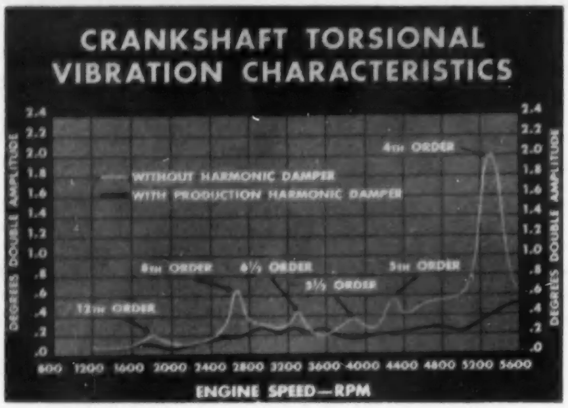


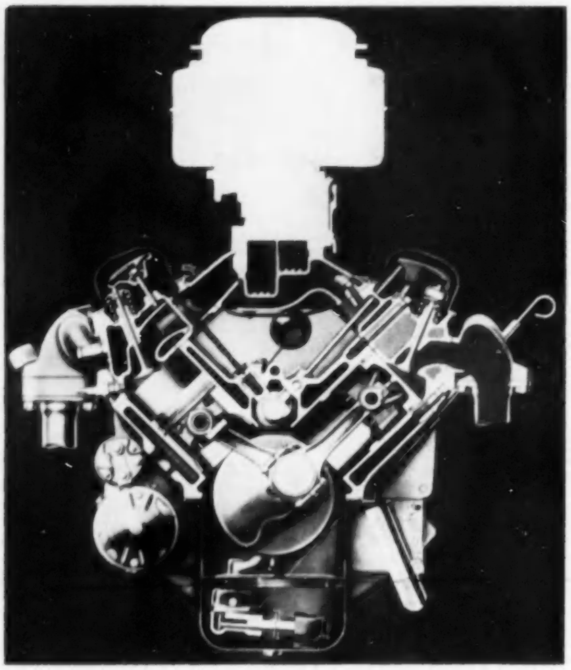
Engine weight reduced 41 lb

Taking unnecessary weight out of an automobile is the same as putting horsepower in and results in increased acceleration ability. So, Chevrolet tried whenever possible to simplify the engine and reduce weight. Below is a comparison of the weights of V-8 and Inline 6 engines:

	V-8	6
Block assembly	147 lb	163 lb
Cylinder Heads (per engine)	77	72
Crankshaft	47	79
Connecting Rod, Piston, Rings	21	22
Intake Manifold	34	13
Exhaust Manifolds	17	16
Valve Actuating Mechanism	18	25
Total Engine	**531**	**572**





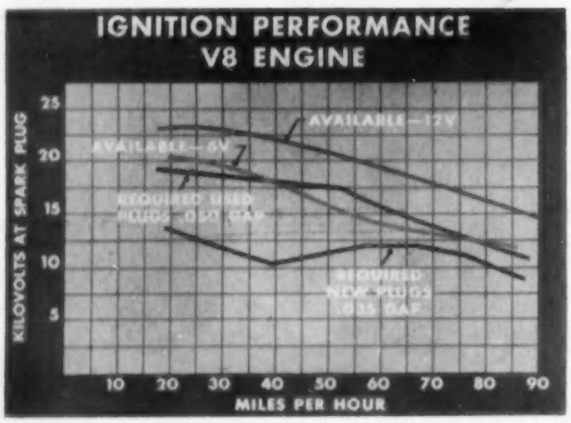


Crankshaft is pressed forged steel

Pressed forged steel was chosen for the crankshaft instead of alloy iron because it has a high modulus of elasticity with a higher specific gravity. New forging processes made it possible to reduce overall length. Here is a chart of the crankshaft torsional vibration. Peaks are quite low and not sharp through the general range. With the addition of a harmonic balancer, torsional vibration was practically eliminated.

Exhaust manifolds near top of cylinder head

To bring the manifold out of the way of the steering mechanism it was placed near the top of the cylinder heads. The exhaust passages point upward and out, and the entire length of the ports, both top and under sides, are water jacketed. This minimizes the transfer of distortion loads back to the valve seats, and dissipates heat uniformly from the valve area.

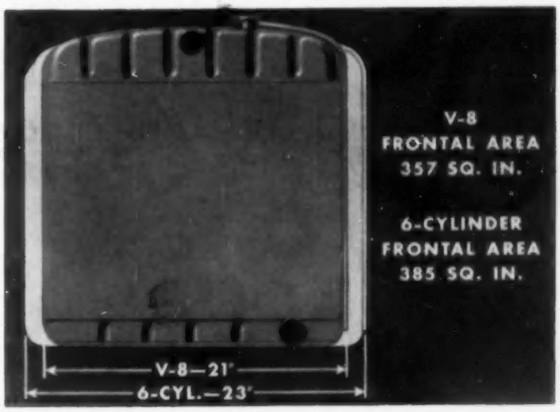


12-v electrical system

Chevrolet goes along with the industry switch from 6-v to a 12-v electrical system. The 6-v system was found unable to supply sufficient voltage for the new high compression engines, especially when spark plugs became slightly worn. The 12-v system provides sufficient ignition reserve throughout the entire operating range with new or used plugs. Also, it permits more efficient generator output, better starting motor operation, and permits the use of smaller gage wires and cables.

Radiator is smaller

Even though the V-8 has a displacement of 30 cu in. more than the 6-cyl engine, and considerably more power, a smaller radiator can be used. Minimum specific heat rejection is 31 Btu per minute per hp at 2800 rpm, totaling 4800 Btu at 4400 rpm. A single pump circulates water at 43 gpm at 4400 engine rpm.

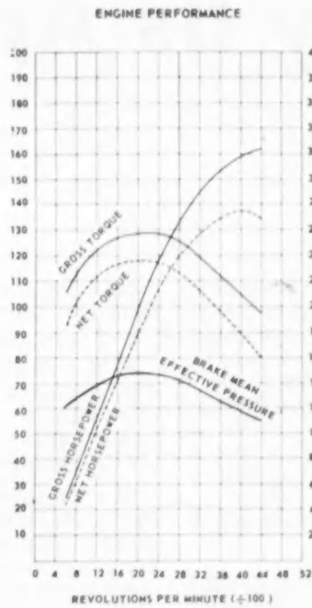


Engine performance

(A) The new Chevrolet V-8, which has a two barrel carburetor, develops 162 gross horsepower at 4400 rpm, and gross torque of 257 lb-ft at 2200 rpm. Bmep is 146.0 psi at 2200 rpm.

(B) Because of its very short piston stroke it produces a low friction hp of only 40.6 hp. Note also the low Fmep curve. Reducing friction hp is another way of adding usable power to an engine. The specific fuel consumption figure of .498 lb per hp-hr indicates excellent economy.

(C) When exceptional acceleration and performance are desired a four barrel carburetor and a dual exhaust system are offered as optional equipment. An engine with this equipment can turn out 180 hp at 4600 rpm and gross torque of 260 ft-lb at 2800 rpm.



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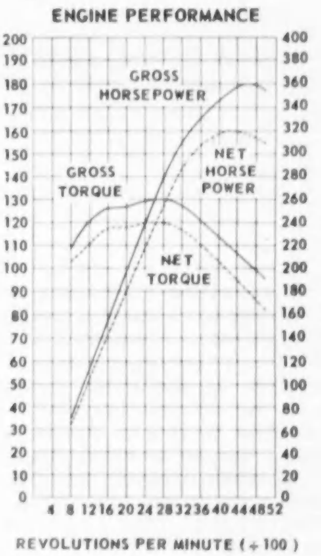

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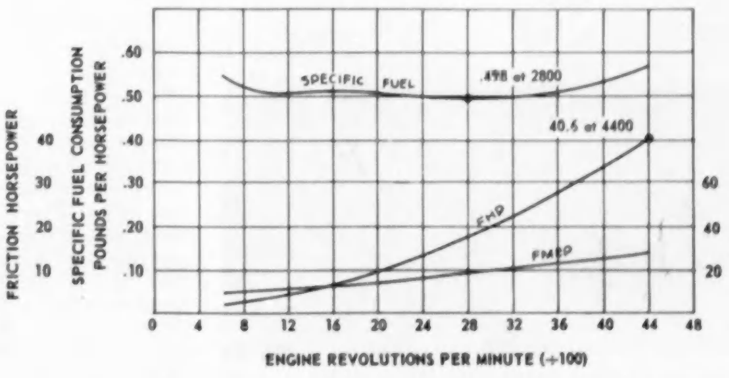

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(Paper on which this abridgment is based is available in full in multilithographed form from SAE Special Publications Department. Price: 35¢ to members, 60¢ to nonmembers.)

You Can't Judge A Block By Its Appearance

A NEW method for finding residual stresses in a cylinder block casting has been evolved by Packard engineers. It's used as a tool for determining how foundry procedures induce trapped stresses in a casting. By modifying casting practices, according to the information obtained from the test, it is possible to reduce considerably the number of failures due to residual stresses. Fig. 1 shows a typical crack between the intake valve seat and a cylinder due to residual stress.

The test procedure, which uses SR-4 strain gages, is as follows:

1. Thoroughly clean all surfaces of the casting where the stresses are to be measured. Carefully hand grind the surface. Mount the gage in the direction of the maximum strain.

2. Take a gage reading.

3. Make a saw cut .062 to .092 in. wide by 1 to 2 in. deep as close as possible to the free end of the strain gage. Fig. 2 shows a close up view of the saw cut on the top of the block.

4. Take gage readings after making the saw cut.

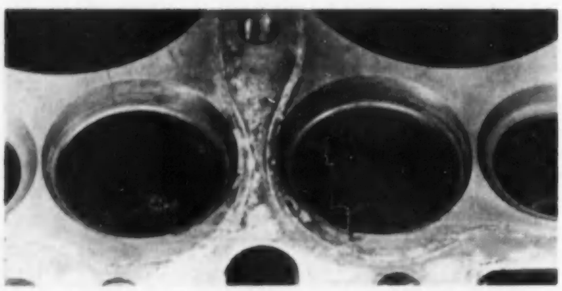


Fig. 1—An engine block may crack due to residual stresses set up during cooling, because different parts of the block cool at different rates

The difference in gage readings measures the strain originally present in the length of metal covered by the grid of the strain gage. The saw cut permits the metal to contract to a value of zero strain. Actually the gage measures the contraction which is equal to the original tension present before the block is cut.

This tension develops primarily because the various parts of an engine block casting cool at different rates. The last part to cool usually developes internal tensions. As shown in Fig. 3 these cooling differentials can be controlled by changing the foundry procedure. The new Packard test provides a means of evaluating procedure changes.

In the past, diagnosing residual stresses and changing foundry practice was a trial and error process. Usually, if a cylinder block cracked, various experiments were made changing the casting or cooling technique until an acceptable method was stumbled upon. But, if a block did not crack, there was no way of telling what the trapped stresses were or how close they were to causing failure. Also, there was no way of telling until after several months of service whether a change in procedure

Beneath the surface there may be stresses that will eventually crack the engine block.

Packard measures these stresses by the difference in strain gage readings before and after a saw cut is made in the block

R. E. Vandeventer and
F. McFarland, Packard Motor Car Co

Based on paper "Measurement and Control of Residual Stresses in Cylinder Block Castings," presented at SAE Annual Meeting, Detroit, January 11, 1954

had eliminated a fatigue failure. The new test gives immediate results.

Several other test methods, using stresscote lacquer, or measuring the distance between points on the casting before and after saw cuts, were tried. But they were not as accurate as the test adopted.

During experiments at the Packard foundry it was found that cooling cracks and residual stresses form during cooling through the range 1400 to 600 deg F. Above 1400 deg the hot portions of the casting can yield and adjust themselves.

It was found that the top face of an engine block cooled slowly and allowed the rest of the block to contract first. Then, when the surface attempted to shrink on cooling, it had to stretch, developing tension. With the new stress test as a guide, the cooling procedure was changed so that the face and the rest of the block cooled at approximately the same rate. This equalized the tension and compression stresses. Changes in procedure were applied with

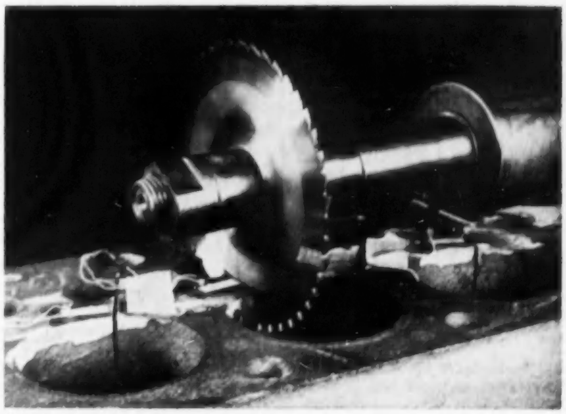
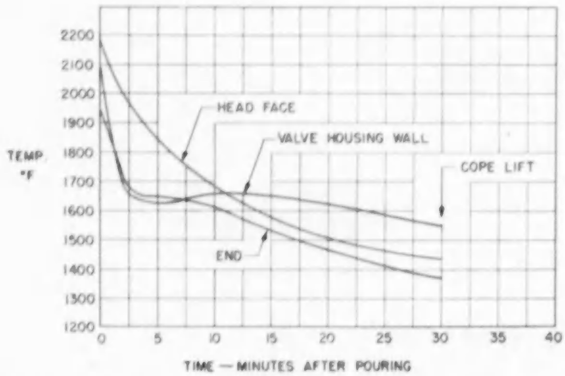
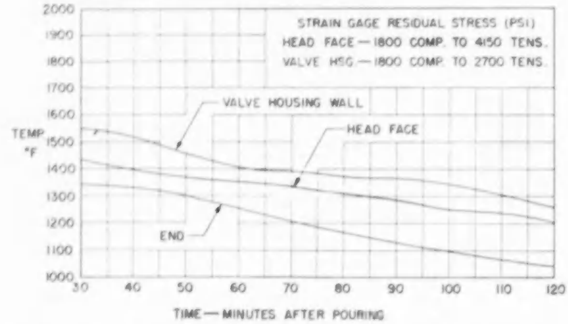


Fig. 2—A saw cut in the top of the block between the SR-4 strain gages will allow the metal to contract. The difference in gage readings is a measure of the strain

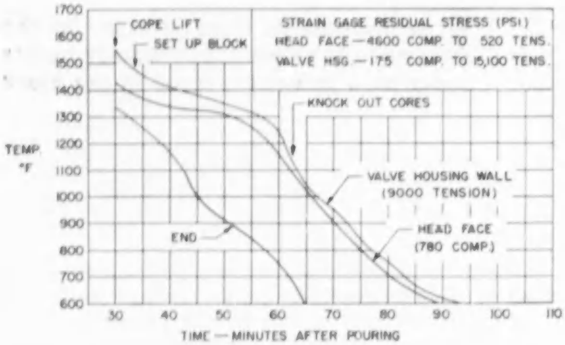
Cooling rate is controlled by changing foundry procedure



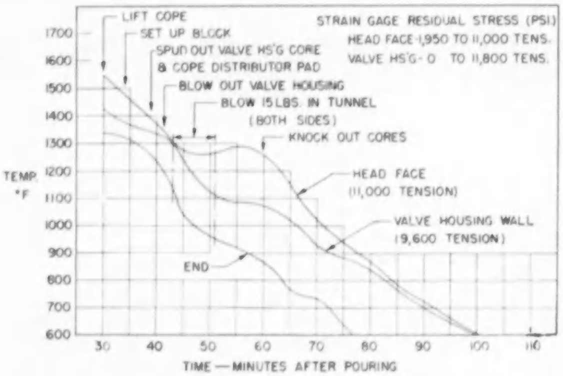
A. Temperature drops quickly during the first ten minutes. Note that the valve compartment is hotter than the head face and end section



B. If a block is allowed to cool in the mold, the same relative difference in temperature continues. But this is an expensive, impractical cooling procedure



C. When the cope is lifted off and cores knocked out, the cooling rate is faster due to air circulation



D. Compressed air accelerates cooling and equalizes temperature differences. Note that the valve housing wall cools more rapidly than the head face from 1300 to 600 deg F

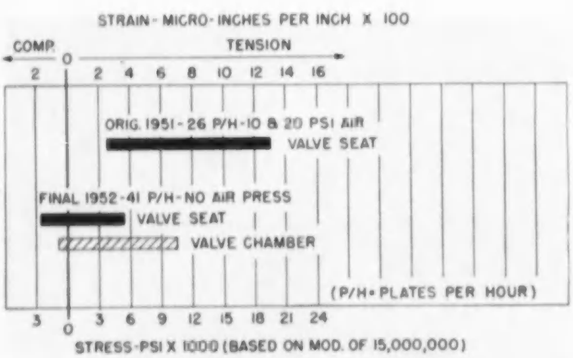


Fig. 4—Cylinder block residual strains were very high in 1951. A year later, after changes had been made in cooling procedure, strain was relieved considerably

discretion so that the trapped stresses would not be chased to another section of the block.

As a result of the experiments at the Packard foundry, cooling tunnel air pressure on either side of the block has been reduced to 0–5 psi. The valve chamber is now thoroughly cleaned out by quick high pressure air blasts. The center of the top slab of sand is still broken up. And the peak line speed is set at 41 plates per hour.

These changes have been in effect for some time now. Fig. 4 shows the original 1951 stresses in the block at the valve seats on the top face, and the final 1952 stresses at the valve seats after the corrective procedures were begun.

The Packard engineering and metallurgy departments are currently working on techniques to determine qualitative stresses more accurately. It is expected that the values will approach the tensile strength of the iron. (Paper on which this abridgment is based is available in full in multilithographed form from SAE Special Publications Department. Price: 35¢ to members, 60¢ to nonmembers.)

Stamping a Package "Fragile" Is Not Enough

To protect a piece of equipment from damage during shipment, it must be packaged and cushioned carefully. A fragility rating would help take the guess work out of packaging.

IF a standard system could be devised that rated the relative fragility of a piece of equipment, then waste due to over-packing and damage due to under-packing could be reduced. First, a complete survey of present packaging techniques and problems must be made. Then, a simple test procedure, and/or test machine must be developed. And more data about packaging and cushioning materials must be gathered. When this is done, a standard code and fragility rating can be established that will take packaging out of the "guessing" stage and put it on a scientific and business basis.

Packaging Is A Vital Problem Today

The Air Force spends ¾ billion dollars annually on packaging its equipment to withstand rough handling. One vital problem in the top priority guided missile program is getting the missile—which may be as large as a light bomber—from the factory to the launching site in good condition. This is important because if any one of hundreds of sensitive electronic circuits in the missile is broken, the accuracy of the missile would be impaired. Then, an enemy missile could get through our defenses with its atomic warhead. Modern air defense requires 100% reliability. That is, every missile must operate perfectly and home on its target. Therefore, during shipping and storing, the packaging must give 100% protection to the missile, no matter what the cost. (It is reported that one container for a guided missile costs more than the missile itself.)

In other cases, however, the cost of the packaging is carefully considered. For example, the Air Force ordered several million 2.75 in. Folding Fin Aircraft Rockets through the Navy Bureau of Ordnance. The rockets were packaged in aluminum containers. Suspecting that the Air Force and Navy storage requirements differed, the Air Force found that the packaging could be modified. The new design has already saved approximately 13 million dollars for the Air Force. The two packs are shown in Fig. 1.

What Do We Know About Packaging?

Particularly during the last few years, a lot has been learned about the shock and vibrations which

Symposium was jointly sponsored by SAE Technical Committee S-8, Aircraft Shock and Vibration Isolation, and Aircraft Activity Symposium Chairman W. L. Hardy, Foster D. Snell Co. Members of the panel were (left to right) W. L. Hardy, Chairman, J. T. Muller, N. J. Dynamic Testing Laboratory; R. D. Hawkins, Sperry Gyroscope Co.; S. M. Birnbaum, Wright Air Development Center; R. Weller, U. S. Naval Air Missile Test Center; J. Cammarata Arma Corp.; W. H. Skidmore, Weston Electrical Instr. Corp.; and F. Mintz, Armour Research Foundation, Sec.

a package undergoes during shipment. It appears that, aside from accidents to the carrier, no in-transit shock is likely to exceed the effect of a 30 inch drop onto a firm floor. Also, fundamental vibration frequencies of any consequence do not exceed 60 cps during transit. At loading, transfer, and unloading points it seems likely that the height of drop would be proportional to the size, weight, and shape of the package. Specifically:

1. If a package is small and light enough to be thrown it is likely to be so treated at every handling station.

2. If the package is too small and light to be thrown it will be handled in bags or baskets. In which case it is likely to be crushed.

3. A small package, too heavy to throw, will probably be carefully hand carried.

4. A large and heavy package may be slid or carried and dropped from a height of 30 to 40 inches.

5. A two-man package will receive careful treatment.

6. Very large and heavy packages requiring mechanical lifting seldom are dropped more than 6 to 10 inches.

This knowledge has enabled industry to save thousands of dollars in packaging. For example, early vacuum tubes were packaged in 3 to 4 inches of soft cushion in all directions. Today, vacuum tube packages have practically no cushion.

A lightweight two-way crate, one half the weight of previous crates has recently been developed for packaging aircraft sections. As shown in Fig. 2, it has an interior unsheathed framework and an ex-

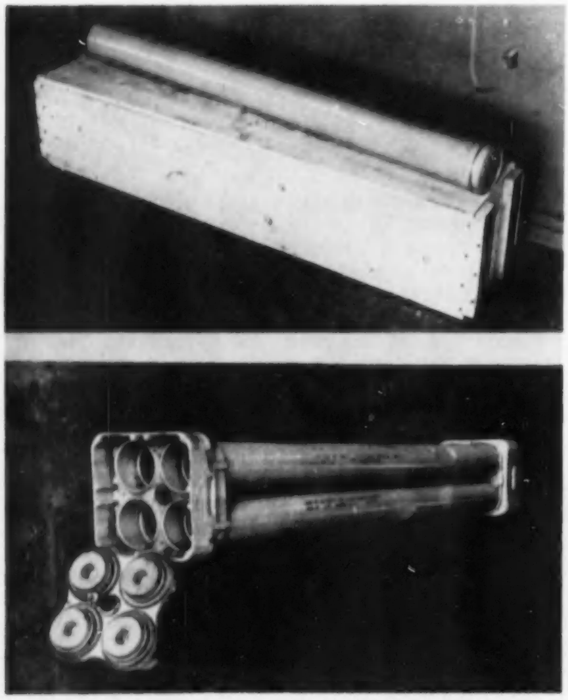


Fig. 1—An expensive aircraft rocket pack (bottom) was replaced by a cheaper wooden case and aluminum tube (top), saving $13,000,000

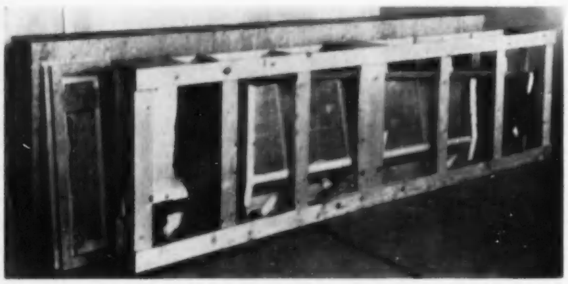


Fig. 2—A new USAF two-way crate has an outersheathing that can be discarded when shipping by air

terior sheathing which can be removed for air shipment.

Experience has shown that boxes made of veneer panel faced with Kraft paper are lighter and perform as well as cleated plywood or nailed wood boxes.

By reducing the size and weight of the cushioning and package, initial package costs, transportation costs, and wasted storage space are reduced. However, too little cushion will allow the article to be damaged. The amount of cushioning to be used depends on the fragility of the article.

Manufacturers Make a "Guesstimate"

Sometimes a manufacturer is able to give the packaging engineer a "guesstimate" of the fragility of piece of equipment. For example: let's assume that the manufacturer of an item one cubic foot in size says that it can withstand an acceleration of 15 g's. To protect this item against a 30-in. free drop, and using latex bound hair as cushion, we would need approximately 10 in. of material on all sides. The size of the package would be 19 cu ft. Now if the item could actually withstand 30 g's, the cushion thickness could be reduced 5 in., as shown in Fig. 3. Total cubage would be only 6.2 cu ft. Thus, overcaution would ship 12.8 cu ft of excess cushioning material. If the actual g value was 45, then only 2.45 cu ft of cushioning is necessary. This saving is particularly important when shipping by air.

So, guessing how fragile a piece of equipment is can be very wasteful. There should be a standard test to help packaging engineers. One method of testing fragility is by high-speed motion photography.

High-Speed Photography "Sees" Shock Damage

High-speed motion picture films of equipment being dropped can be analysed to provide accurate measurements of displacement velocity and acceleration due to shock.

The camera uses a rotating prism instead of a mechanical shutter. It rotates in sync with the movement of the film and causes the image to follow the moving film during the exposure interval of each frame. The film runs through the camera in one continuous motion at 100 fps. When the film is projected at normal speeds, actions which happened in fractions of a second can be observed in slow motion.

Fig. 4 shows what happened during the shock test of a vacuum tube. The distance on the film between a stationary reference point and the object can be measured. Then velocity and acceleration are calculated for each time interval. Fig. 5 shows a typical displacement-time curve.

There are many advantages of using motion picture photography over the more conventional and better known ways of measuring shock and vibration. (See discussion for information about other methods.)

1. It is a visual method and seeing helps understanding. All data can be related directly to what the eye sees.

2. It is a direct method which does not depend on calibration of other instruments. One picture

Packaging Symposium

This article is based on papers presented at the Symposium "Compatible Design of Equipment and Its Packaging," which took place at the SAE Los Angeles Aeronautic Meeting, Oct. 7, 1954. Papers are entitled:

Optimum Properties of a Packaging Material

J. T. Muller

Sperry Gyroscope Co.

Air Force Packaging Problems

S. M. Birnbaum

Wright Air Development Center

Fragility Rating For Aircraft Equipment

W. H. Skidmore

Weston Electrical Instrument Corp.

High-Speed Motion Picture Photography as a Tool in Shock and Vibration

R. D. Hawkins

Sperry Gyroscope Co.

Discussion—"Instrumentation For Recording Packaging Shock and Vibration"

F. Mintz,

Armour Research Foundation

They are available in full in Multilithographed form from SAE Special Publications Department. Price: 35¢ each paper to members; 60¢ each paper to nonmembers.

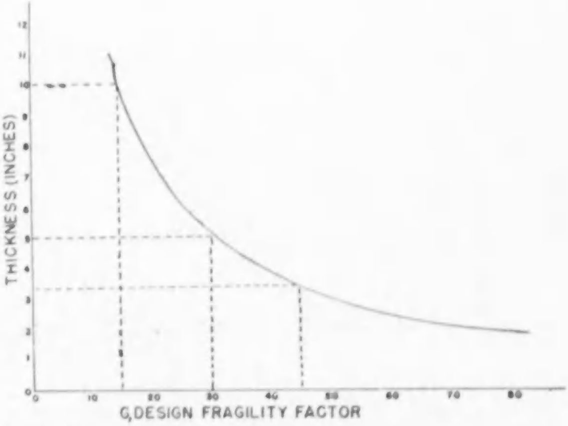


Fig. 3—This curve shows the relation between Fragility, expressed in g's and the thickness of latex bound hair cushioning material. Data are computed on basis of a 30-in. free fall

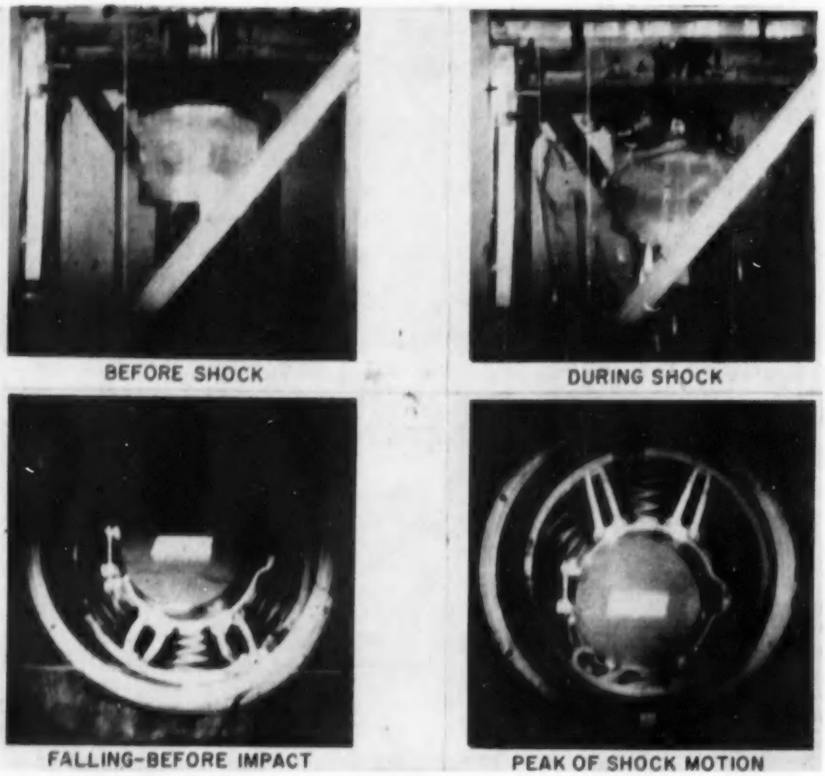


Fig. 4—(above) High-speed motion photography shows what happens to a vacuum tube undergoing shock. (below) The action of suspension in a container during a drop test is photographed

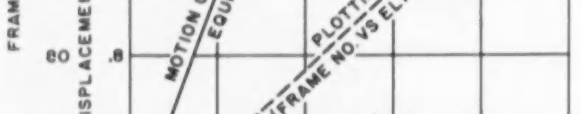


Fig. 5—Displacement-time curves, plotted from data obtained with high-speed motion photography, show the motion of a container and equipment protected by cushion inside the container. The difference between curves indicates the amount of compression of the cushion

provides information which—with other methods—would require six or more pick-ups and a multi-channel recorder.

3. It can be used to pick up very accurate displacement measurements of very small equipment.

4. With experienced personnel, film analysis requires only 15 to 20 man hours. Frequently, just viewing a film reveals obvious malfunctions in equipment which makes measurements unnecessary.

But high speed motion photography has certain limitations.

1. It is not practical where many routine or repetitive measurements are required.

2. It cannot be used to measure high frequency accelerations of low magnitude because the displacements are too small.

3. It cannot be used unless the motions to be measured can be made visible to the camera.

High speed motion photography is a research tool of unquestioned value. By correct film analysis it is possible to study packaging tests and get complete

qualitative and quantitative information. This information, however, must be put to practical use. A "fragility rating" is one suggested method.

Fragility Rating Is Difficult

No matter what type of test machine or procedure is devised, the data obtained must be correlated to some standard and made available for use. Rating the fragility of an object would help engineers design adequate cushioning. This index would be based on the largest shock and the largest number of shocks an object could withstand without damage. That is, the highest number of deceleration g's, and the frequency of vibration an item can tolerate without damage.

The rating would have two parts: the g portion, and the resonance portion.

A preliminary survey of manufacturers throughout the country was conducted by SAE Committee on Aircraft Shock and Vibration Isolation. The manufacturers were asked to give a fragility rating on their products.

Fig. 6 is a summary of some of the replies. G numbers ranged from 5 to 75, indicating the products ranged from "extreme delicacy" to "very rugged."

To determine the maximum *g* number which an object can withstand, acceleration, time, and the shape of the transient shock wave must be considered. But it is very difficult to estimate just how many shocks an article will receive during shipment. Therefore, it is proposed that a laboratory test be devised on the basis of ten shocks in each of three mutually perpendicular directions; plus ten additional shocks of the same magnitude, time and wave shape, from the most vulnerable direction. This would allow approximately four significant shocks at each of ten handling depots. Of course, for larger, heavier articles, or articles shipped with a specified side up, a different test may be devised.

A comprehensive test and accurate fragility index is a very difficult accomplishment because of all the variables which must be considered. But it is necessary so that cushioning material and packages can be designed to protect the object with a minimum of cubage and tare weight.

The type of cushioning material needed for a given fragility rating can be calculated from data obtained by a simple dynamic load test. Also the resiliency of different materials can be judged. This may lead to the use of new cushioning materials and packaging designs.

Based on Panel Discussion

E. Mintz, Armour Research Foundation

There are many pick-up and recording devices for sensing and recording vibration and shock. The relative motion of the object and the package can be detected by mechanical, optical or electrical means or combinations of these. In general, mechanical sensing and recording devices are used when the motions are large. Electrical pick-ups are more sensitive. The vibration is usually amplified and fed to a direct-writing recorder, oscilloscope, or magnetic recorder.

Besides laboratory tests, data can be obtained by putting a recording instrument inside a package which is shipped over specified routes. The analysis of such a long-term continuous record is a long, arduous task. Also, the weight and bulk of the recording equipment adds complications. No really satisfactory instrumentation has yet been devised for this type of testing. One instrument which shows promise for the future is a multi-reed gage suitably designed to facilitate the analysis of data.

C. T. Morrow, Hughes Aircraft Co.

The reed gage is ideal for measuring shock but not suitable for steady vibration. To define shock, a "shock spectrum" is needed, but to define vibration a Fourier analysis is desired.

Nomenclature	Mfr.	Weight Lbs.	Dimensions	Loading Low	P.S.I. High	• When verified Fragility Rating
Accelerometer	A	1.5	4.5 x 2.4 x 2.4	.14	.26	•5-29
Communication Equip.	B	50.0	19 x 14 x 8	.19	.45	•10-33 •
Indicator, True Air Speed	A	4.0	6.2 x 3.1 x 3.1	.21	.41	5-75 •
Indicator, Thermocouple Temp.	C	1.25	2.6 x 3.3 x 3.3	.11	.15	25-50/60
Indicator, Thermocouple Temp.	C	1.10	2.6 x 3.3 x 3.3	.10	.13	25-50/60
Indicator, Thermocouple Temp.	D	1.10	2.5 x 3.3 x 3.3	.10	.13	•50-50 •
Time, Mercury Delay	E	34.0	24 x 2.5 x 2.5	.57	5.45	•10-75 •
Receiver, Radio	E	73.0	19.5 x 15 x 10	.25	.49	•25-55
Sextant, Periscopic (in case)	A	21.5	17.5 x 10.5 x 8	.12	.26	•25-15
Transducer, Abs. Press.	A	2.0	5.5 x 4.5 x 2.8	.08	.16	10-75 •
Transmitter, Radio	E	520.0	36 x 36 x 30	.40	.48	25-35/45
Voltmeter, A.C.	F	.37	2.7 x 2.4 x 2.4	.06	.06	75-42 •
Voltmeter, D.C.	F	.50	2.1 x 2.4 x 2.4	.09	.10	75-42 •
Voltmeter, D.C.	D	.60	2.0 x 2.4 x 2.4	.10	.13	•50-50 •

Fig. 6—A survey of manufacturers, which asked them to rate the fragility of their products, uncovered the above information

It may not be easy for the fleet man to decide if he should farm out repair work or do it himself. Here are some hints to help him decide . . .

When to Farm Out

The panel that led the discussion on which this article is based consisted of:

Leader:
Fred Hague, Sun Oil Co.

Secretary:
Murray Simkins, Commercial Car Journal

Panel Members:

Harry Cooke, Penn Fruit Co.

A. A. Dach, Supplee-Wills-Jones Milk Co.

H. H. Earl, United Parcel Service

F. K. Glynn, American Telephone & Telegraph Co.

C. H. Ruth, Jr., Washington Evening Star

R. D. Sidel, Metropolitan Distributors, Inc.

W. R. Hilton, Mason & Dixon Lines, Inc.

THERE seems to be no pat answer to the question so often asked by the fleet operator, "should I do my own repair work or should I send it out?"

In the first place, the question is not that simple, for every operator does some repair work and no operator does all. Even the small fleet owner will do his own servicing and make repairs too minor to send out. At the other end of the scale, the large operator with a well-equipped shop will, at times, send out at least some of his work to specialists. So the problem might be stated more accurately, "When, where, and how much of my repair work should I send out?"

Unfortunately, nobody can give a direct and simple answer to that question. Each operator must figure it out for himself. Moreover, he must figure it out for each separate type of repair job. There appears to be no clearcut pattern that would fit more than one operation.

Experienced operators have, however, devised certain hints that should prove helpful to others faced with the same problem.

Keep Records

First and most important of all, the operator must keep accurate, complete, and up-to-date records. These are absolutely essential because they form the basis for any comparison between his costs with those submitted by outside shops for similar work.

This collecting and checking of facts and figures

Fleet Repairs

Murray Simkins, Commercial Car Journal

Report of Round Table discussion on, "Where and When Does It Pay to Send Certain Parts and Units to Outside Garages for Repair," held during the SAE Summer Meeting, Atlantic City, June 7, 1954.

must be done constantly and consistently because conditions are continually changing. One year it might pay him to do his fuel pump repairs, another year a specialist might be found who could do this job better, faster, and maybe even cheaper than the operator could. At one time the operator might repair his own radiators; later he might find that it was no longer expedient to do so.

For instance, one company operating nearly 4000 trucks in the Metropolitan area farmed out its ignition work to a prominent repair shop in its vicinity. Management had what it considered was a reasonable and fair arrangement as to price, performance, and guarantee. As company needs grew, the bills grew, and so did the troubles. Finally, management was forced to study the possibility of setting up a shop of its own to do this work. After getting the figures together, it concluded that it could (1) put a first-class ignition specialist on the payroll and, (2) after adding a fair overhead, plus cost of material, end up with a total amount that would be substantially lower than the monthly bills were.

It was tried—and within six months the number of jobs had been cut down, road calls had been reduced on these items, and other duties had been added to those of the ignition mechanic. The records in this particular case show that the operator is performing this work at about 30% under market prices.

At least once a year, this company compares its costs, checking time and material against outside competition. The overall saving is in the neighborhood of 30%. In addition, in most cases the quality of the work is considered superior and it is done much more quickly.

Making the analysis that brings such information to light is not as simple as it may seem. First, the actual cost of getting the job done must be computed—and this figure, to be true, must include administrative costs as well as actual shop costs. To get a completely realistic picture, however, the operator must take into consideration the life of the part as repaired by himself, compared with its life when it is repaired on the outside. It takes plenty

of paperwork to give the data needed for an analysis of this type.

Even though the cost analysis favors one of the methods, the operator should consider other factors before he makes his decision. Each method has advantages that he should weigh as he studies his own operation.

Advantages of Farming Out

Farming out, for example, may produce such benefits as these for him:

1. He doesn't have to build (or rent) and maintain an extensive repair shop and hire men to run it.

2. He can maintain lower parts inventory.

3. Operation under a guaranteed maintenance program means that he knows ahead of time his approximate maintenance costs.

4. An outside shop may be found that does a better job of keeping up with new techniques and processes than his own mechanics do.

Advantages of Doing Own Work

On the other hand, if the operator does his own work he may find that:

1. His repair crew can be set up so that it goes out immediately to equipment broken down on the road, no matter what hour of the day or night, whether Sunday or holiday, if necessary. (This practice saves breakdown pay for the driver and gets the equipment back in operation promptly.)

2. His own shop can be set up so that repairs are performed as promptly as possible—saving the heavy cost of idle equipment time. (It seems to be common experience that outside shops consistently tie up equipment twice as long as company-owned shops.)

3. There is no delay and expense in transferring equipment to and from the outside shop.

4. Experience in making his own repairs can often help the operator avoid the trouble in the first place.

5. His own shop can be designed to take care of special equipment and devices, such as the mechanical devices used on gasoline cargo tanks.

6. It is easier to institute any special maintenance practices that seem desirable to management.

7. Productive changes can be made when needed at the discretion of the supervisor because he understands his company's operation as no outside shop ever could.

8. Less delay time means fewer vehicles are needed.

9. Fewer parts are needed than under a guaranteed maintenance program if, under the latter, parts are replaced on a mileage basis. Parts will then often be replaced even though they still contain valuable miles, for it is impossible to predict just how many miles a part will give.

10. His own salvage parts can be used in making repairs.

Other Factors

Some of the factors that have been found to have a bearing on the operator's decision are:

1. Size of fleet. (If the fleet isn't more than 20 or 30 vehicles, it probably won't be worth while for the operator to do much of his own repair work.)

2. Number of replacement vehicles available.

3. Proximity to repair facilities.

4. Labor market.

5. Type of business served.

6. Extent and ability of mangement.

Also to be considered is the need for flexibility. Thus, many operators that do most of their own work still like to farm out some of it to give them a flexibility of operation that they otherwise wouldn't have. This gives them sources that know their requirements and that then can be called upon to help out when their own shops are overloaded with work. It also has the advantage of giving them a standard with which to compare their own costs. In this way they can continually check whether it is better for them to continue to do most of their own work or send it out.

Despite all fancy analyses there are a few situations where the operator may be forced to do all his own repair work. For example, if his operation is too remote from satisfactory outside facilities, he must do his own work, no matter what the cost. This might also be true if his equipment is so highly specialized that he can't find an outside shop equipped to take care of it. The more standard and commonplace one's equipment, the easier it is to find a garage to service it. It's always easier to get passenger-car engines repaired than more specialized powerplants.

A well-equipped shop allows the operator to get his work done quickly and to his own specifications. On the other hand, it means he must carry the expense of maintaining the shop and hiring men to run it. Deciding which is a better system can be a headache in itself

Correcting Brake Faults Shortens Stops Significantly

F. William Petring, Highway Transport Research Branch, U. S. Bureau of Public Roads

Based on paper "Improvement in Stopping Ability of Motor Trucks in Use on the Highway" presented at SAE Summer Meeting, Atlantic City, June 7, 1954.

GOOD brake maintenance pays off in significantly shorter stops. This fact the Bureau of Public Roads has dramatically demonstrated by tests on 64 trucks borrowed from operators all over the country.

To show what can be done, the Bureau determined stopping distance of each truck from 20 mph, then put the braking system in good order, and re-measured stopping distance.

After brake faults were corrected, stops were as much as 40% shorter.

These test vehicles came from owners who were "maintenance minded" enough to lend their equipment for the tests. Chances are that this sample was better maintained than the general truck population. If that's so, adequate brake maintenance could accomplish even more spectacular results with the bulk of the country's trucks. (The tests were run in 1949, but the results are just as meaningful today.)

Fig. 1 presents a general picture of the improvement made in the stopping ability of the vehicles. Note that only 68% of the vehicles could stop within 50 ft from 20 mph when first tested. But 87% of them could stop in 50 ft or less when returned to the operators.

A summary of the average percentage of improvement in stopping distance is shown by vehicle type in Table 1. Considering the results for the initial speed of 20 mph, it is particularly significant that approximately three-fifths of the average total improvement of 15.3% was accomplished by a brake adjustment which consisted of simply taking up the slack between the brake shoes and the drums.

Closer analysis showed that simple brake adjustment accounted for most of the improvement in the vehicles with stopping distances under 50 ft. Those with longer stopping distance required more extensive correction. In the short time the vehicles were available for repair work, BPR mechanics cut stopping distance to less than 50 ft on 11 of the 20 vehicles originally requiring more than 50 ft.

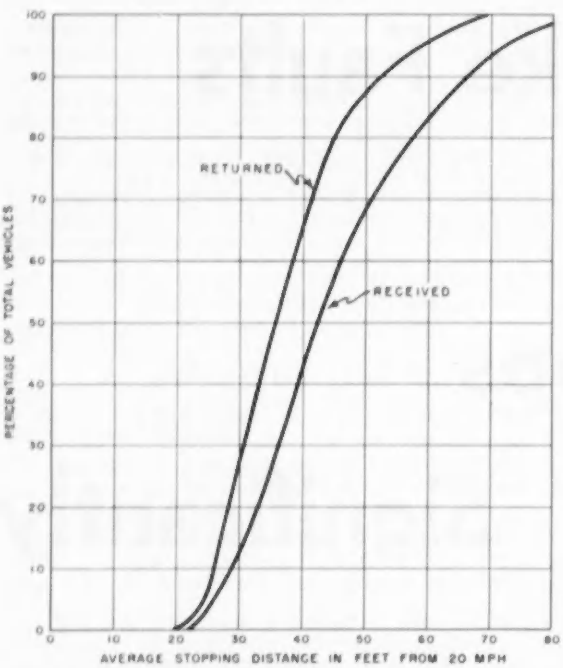


Fig. 1—Before and after. Cumulative frequency distribution of vehicle stopping distances measured for all types of trucks and combination units selected from service for tests

With more time, all the vehicles could have been made to stop within 50 ft from 20 mph.

Fig. 2 shows why mechanics directed most of their effort at taking up the slack between brake shoes and drums and making other changes to cut application and build-up time. It is a time-speed record showing the sequence of events that occur during the stopping of a commercial vehicle with power brakes. There is one period immediately following the instant the braking controls are operated, called "application time," during which the vehicle is not retarded appreciably. This time or distance is required to transmit power to the brake chambers and to overcome frictional resistance in the linkage between brake chambers and shoes and resistance of the brake shoe return springs. The application time is followed by a second period, called the "brake force build-up time," during which the braking force at the wheels is building to a maximum value.

The phenomena of application and build-up times are complicated by the fact that they are usually different to some degree on each axle of a vehicle. The time-speed record shows the composite effect of the timing of the forces at the individual axles. The final period of the braking cycle is indicated as "maximum sustained deceleration." It is the period during which the maximum braking force is acting to stop the vehicle.

For the example shown in Fig. 2, the application time is 0.26 sec, the build-up time 0.89 sec, and the period of maximum sustained deceleration 1.44 sec. These times converted to distance traveled are 8 ft, 22 ft, and 14 ft, respectively. It is significant that the combined application and build-up time constitutes only 44.4% of the vehicle stopping time of 2.59 sec but 68.2% of the vehicle stopping distance of 44.0 ft.

The importance of reducing application and build-up times to a minimum is readily apparent. If the maximum sustained deceleration of 14.1 ft per sec could have been sustained from the instant

Table 1—Average improvement in vehicle stopping distance by vehicle types through maintenance and repair of trucks and combination units selected from service

Vehicle type (truck axles—trailer axles)	Number of Vehicles	Average percentage of improvement for initial speeds of: 20 mph Brake adjustment only	20 mph Total	30 mph	40 mph
2	4	9.3	10.5	6.2	8.8
2-S1	22	8.9	16.2	16.4	17.6
2-S2	12	6.5	10.2	8.4	11.1
3-S2	4	13.4	17.6	19.6	21.2
3-2	3	12.7	24.7	23.9	22.0
3-3	8	5.7	12.3	11.3	10.0
2-S1-2	8	12.2	21.8	20.4	19.3
2-S2-2	2	10.8	13.5	15.2	13.2
Weighted average		9.0	15.3	14.6	15.4

the brake control was first moved, the vehicle stopping distance would have been 30.5 ft.

The phenomena shown by Fig. 2 help to explain why the simple brake adjustment was so effective in reducing vehicle stopping distances. When the clearance between the brake drum and lining is excessive, the mechanism which spreads the brake shoes needs to move a relatively long distance to apply the brakes. Whenever the clearance between the drum and lining is reduced, the distance the operating mechanism moves is shortened, and the time required to apply the brakes is reduced.

Since the vehicle is traveling at its greatest speed during the period designated as application time, any reduction in application time will produce a greater reduction in stopping distance than a similar time reduction at any other period during the stop. Also, in the case of air brakes and vacuum brakes, whenever the distance the slack adjuster arm and push rod must travel is reduced, the amount of air which must pass into or out of the brake chamber is likewise reduced. This, of course, shortens the brake force build-up time, which in turn shortens the vehicle stopping distance.

Table 2 summarizes the corrective actions taken on the 20 vehicles requiring 50 ft or more to stop from 20 mph. (Figs. 3–6 explain treatment and results in four specific cases.)

Brake adjustments were performed on 19 of the 20 vehicles. The replacement of relay valves and the changes in plumbing set-up are next in order and were usually instrumental in reducing application and brake force build-up time.

In replacing relay and control valves and making changes in plumbing on both air-equipped and vacuum-equipped vehicles an effort was made to eliminate, wherever possible, any condition which would tend to retard the smooth flow of air through the system. This was accomplished by (1) installing properly functioning relay, relay emergency, and brake control valves of adequate capacity; (2) eliminating all street elbows and by substituting straight fittings for elbows of any type wherever possible; (3) eliminating unnecessary fittings and lengths of tubing; (4) replacing any tubing which was pinched or kinked; and (5) by replacing tubing of improper diameter with larger or smaller diameter tubing, as necessary.

A malfunctioning or sluggish relay, emergency relay, or brake control valve will adversely affect the brake performance of a vehicle making an emergency stop by increasing the application and brake force build-up time, and in some instances by limiting the maximum braking force. It is imperative that all relay, emergency relay, and control valves function properly and be immediately responsive to any call for action. It is equally important that these valves all have adequate capacity to do the job required of them. A valve of inadequate capacity will stretch out the application and brake force build-up time just as surely as a sluggish valve. There were three instances where the effect of new relay valves on the brake performance could be singled out, the percentage of improvement being 3.3, 5.9, and 19.5%.

When the brakes of an air brake equipped vehicle are applied, compressed air flows from a reservoir through a system of tubing, fittings, and valves into

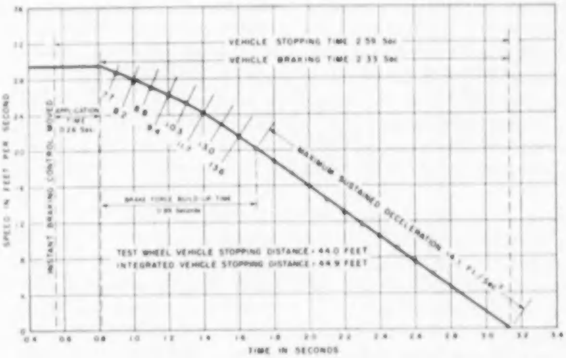


Fig. 2—Time-speed curve for a particular test vehicle stopping from 20 mph, showing differentiation for deceleration and illustrating various phases of the stop

CORRECTION—Install a new type of relay emergency valve on the semitrailer and a new relay valve on the truck tractor. Change a ⅜-in.-diameter line from the tank to the relay emergency valve on the semitrailer to ½-in.-diameter line. Take up the slack between the linings and the drums.

Table 2—Frequency of maintenance and repair work performed to improve vehicle stopping ability on 20 vehicles requiring 50 ft or more to stop from 20 mph

Description of work	Number of Vehicles
1. Adjust brakes	19
2. Replace relay valves	9
3. Eliminate elbows, tees, and lengths of line from air or vacuum plumbing system and change sizes of lines	9
4. Increase application pressure through adjustment of pedal stop or control valve linkage	5
5. Increase tank pressure through new governor or adjustment of limits	4
6. Reline brake shoes	4
7. Replace drums	4
8. Remove synchronizing valve	4
9. Replace foot control valve	3
10. Increase brake chamber sizes	2
11. Increase reserve tank capacity	2
12. Replace slack adjuster or slack adjuster arm	2
13. Eliminate leaks	2
14. Increase brake arm lengths	2
15. Connect front wheel brakes	2
16. Lubricate linkage including slack adjusters	1
17. Doctor linings	1
18. Replace brake chambers	1
19. Tighten anchor plates	1
20. Install converter dolly with brakes	1
21. Replace brake camshaft and anchor pins	1

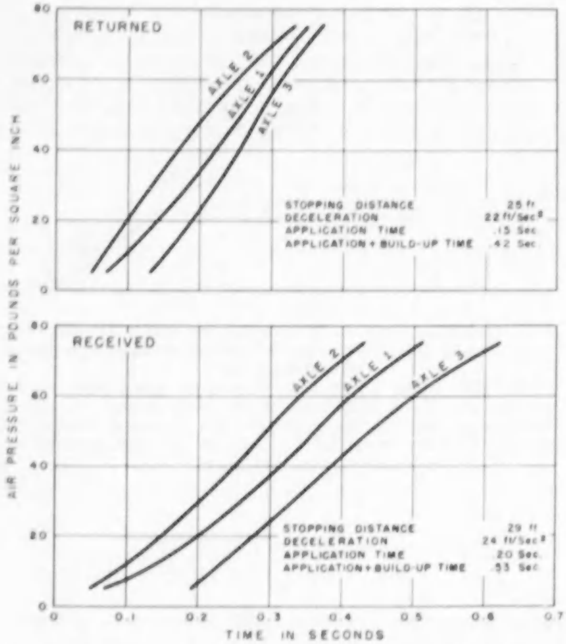


Fig. 3—Build-up of air pressure at brake chambers of a two-axle truck-tractor and a one-axle semitrailer weighing 40,750 lb
CORRECTION—Adjust brakes. Replace all old plumbing on both truck and trailer with a new set-up eliminating unnecessary fittings and tubing. Install a new type of foot control valve and two new relay emergency valves on the trailer. Reline front brakes on the truck.

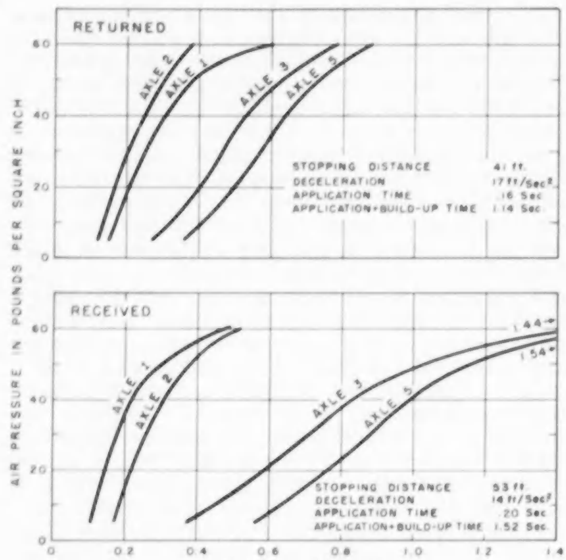


Fig. 5—Build-up of air pressure at brake chambers of a two-axle truck-tractor, one-axle semitrailer and two-axle trailer weighing 76,150 lb
CORRECTION—Adjust brakes. Eliminate leaks in vacuum system on semitrailer. Install new relay valve on semitrailer. Replace brake drums on Axle 3. Replace brake cam, camshaft, camshaft bearings, and inner wheel bearings on right wheel of Axle 3. Replace anchor pins at both wheels of Axle 3. Reline brakes on Axle 3 with stock lining. Doctor linings on Axle 3. Reline brakes on Axle 2. Replace ¼-in.-diameter rusty pipe control line on semitrailer with ½-in.-diameter copper tubing. Reline Axles 2 and 3 with high friction lining.

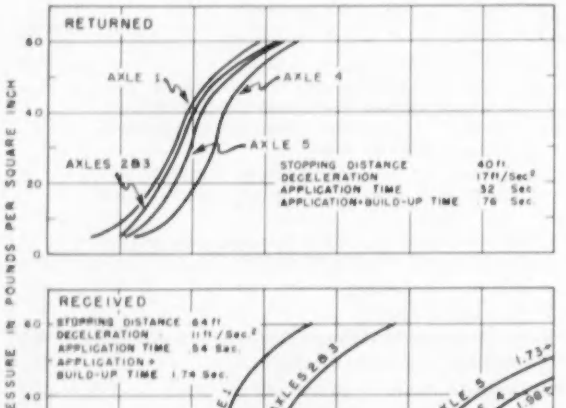


Fig. 4—Build-up of air pressure at brake chambers of a three-axle truck and two-axle trailer weighing 77,740 lb
CORRECTION—Adjust brakes. Eliminate unnecessary fittings and tubing from the truck tractor and trailers. Add a converter dolly with brakes. (Build-up time on this dolly happened to be excessive. Had it been more rapid, the improvement in performance, especially from the lower speeds, would have been greater.)

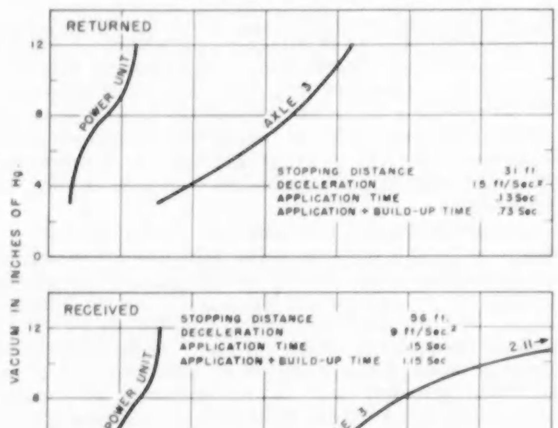


Fig. 6—Build-up of vacuum at hydraulic power unit of a two-axle truck-tractor and at brake chambers of a one-axle semitrailer with combined weight of 40,250 lb

the brake chambers where it operates the mechanism which actuates the brake shoes. In a vacuum brake system air must flow through a series of tubes, fittings, and valves, also. But it flows at less than atmospheric pressure, and, except for vacuum suspended boosters, the direction of flow is reversed. In other words, to actuate the brakes of a vacuum system, air is exhausted from the brake chambers, and it flows *into* a reservoir instead of being forced under pressure from a reservoir into the brake chambers, as in an air brake system. In either system, the more rapidly the air traverses its course, the shorter the application and build-up time will be.

To hold the application and build-up time to a minimum the air must travel through the lines at high velocity. Whenever the smooth inner surface of a line is interrupted or its cross sectional area is abruptly changed, a certain amount of resistance is offered to the rapid flow of air through the line with a resulting increase in application and build-up time. The ordinary pipe street elbow is one of the worst offenders among the fittings which retard the rapid flow of air through a brake system, yet it is very commonly found on vehicles in the everyday traffic. The opening in the small end of a ⅜-in. ordinary street elbow is no larger than the inside diameter of a piece of ¼-in. pipe, and the opening in the small end of a ¼-in. street elbow is no larger than the inside diameter of ⅛-in. pipe. If an elbow must be used, the regular pipe elbow with a close nipple will offer less restriction than the street elbow; but an elbow having a machined inner surface, such as the brass fittings specifically designed for use with copper tubing, is preferable.

Wherever a straight fitting and a fairly long radius bend in the connecting tubing can be used in place of an elbow, there will be some small increment saved in the application and build-up time. If a fitting can be eliminated completely, another small increment of time will be saved.

An example of what can happen when elbows are eliminated is illustrated by the work done on a two-axle truck tractor with one-axle semitrailer and two-axle full trailer equipped with air brakes. Fifteen elbows of various types were removed from the braking system of this vehicle. Straight fittings were substituted for some, and some were completely eliminated. From 20 mph the stopping distance was reduced by 4 ft, from 30 mph it was reduced by 9 ft, and from 40 mph it was reduced by 16 ft. This much improvement is probably not typical of the results which will be obtained by merely removing 15 elbows from a braking system. However, it is a specific example of what has been done.

In general the most improvement will be made by removing the restrictions through which the greatest amount of air must pass. In other words, an elbow between a relay valve and a brake chamber would tend to retard brake action considerably more than the same type of elbow in the service line on the top of the relay.

Worthwhile savings can sometimes be effected by eliminating unnecessary lengths of tubing. It follows that if the distance the air must travel is shortened, the time will also be shortened. In some instances needless lengths of tubing may be eliminated by making circuitous paths of the lines more direct. Sometimes more strategic placement of various brake components, such as reservoirs and relay valves, is possible. For best brake performance a relay valve should be centrally located among the brake chambers it must serve, and the reservoir should be as near as possible to the relay it serves. Pinched or kinked tubing should be corrected whenever discovered.

Increasing application pressures and tank pressures, relining brakes, replacing drums, removing synchronizing valves, replacing foot control valves, and repairing leaks were also among the more common corrective measures. There were three instances where the improvement made by remodeling the plumbing set-up could be definitely assigned as 7.3, 4.4, and 1.6%.

The same type of information shown in Table 2 for those vehicles requiring 50 ft or more to stop from 20 mph is shown in Table 3 for 43 vehicles requiring less than 50 ft to stop. The list of repairs is shorter and the frequency on the basis of percentage is naturally less than for the poorer performers. Although considerable work was performed on the plumbing systems, the results were not startling. The greatest improvement from 20 mph was 3 ft and the average about 1 ft.

(Paper on which this abridgment is based is available in full in multilithographed form from SAE Special Publications Department. Price: 35¢ to members, 60¢ to nonmembers.)

Table 3—Frequency of maintenance and repair work performed to improve vehicle stopping ability on 43 vehicles requiring less than 50 ft to stop from 20 mph

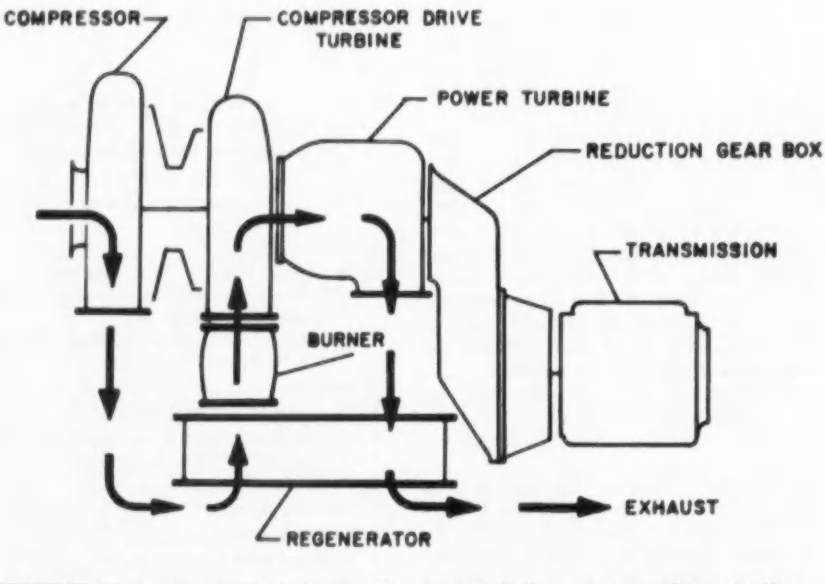
Description of work	Number of vehicles
1. Adjust brakes	37
2. Eliminate elbows, tees, and lengths of line from air or vacuum plumbing system and change sizes of lines	10
3. Increase tank pressure through new governor or adjustment of limits	7
4. Replace relay valves	5
5. Increase brake arm lengths	5
6. Increase application pressure through adjustment of foot control valve	1
7. Reline brake shoes	1
8. Replace drums	1
9. Replace master cylinder	1
10. Replace foot control valve	1
11. Replace check valve	1
12. Install higher friction lining	1
13. Remove grease from lining	1
14. Tighten relay mounting	1
15. Remove synchronizing valve	1

Practical Gas Turbine Auto

THE KEY to achieving a practical automobile gas turbine is in developing high efficiency, broad range components and effective regeneration. Ford Research and Engineering Laboratories feels the best way to accomplish this is by thoroughly investigating and improving the components separately, rather than trying to build a complete gas turbine—which at the present time could not compete with the piston engine.

Problems uncovered by the test program, and still unsolved, include the need for (1) high heat release rates, (2) effective regeneration at minimum size and pressure loss, (3) better fuel economy, (4) faster acceleration, (5) suitable controls to maintain optimum conditions throughout the load range.

To facilitate testing the turbine, components were designed as separate pieces, but they were ducted together for operation as a complete regenerative free turbine.



FLOW ARRANGEMENT of the components is shown above. Air is drawn into a compressor and then preheated by the turbine exhaust gas in a regenerator before it enters the burner. There it expands into the compressor drive turbine. The exhaust from this turbine is further expanded in a free second stage or power turbine where the useful power output of the engine is developed. The power turbine exhaust then passes through the regenerator and finally to the exhaust system.

The power turbine is mechanically free from the compressor turbine assembly, but is connected to the vehicle transmission through reduction gears.

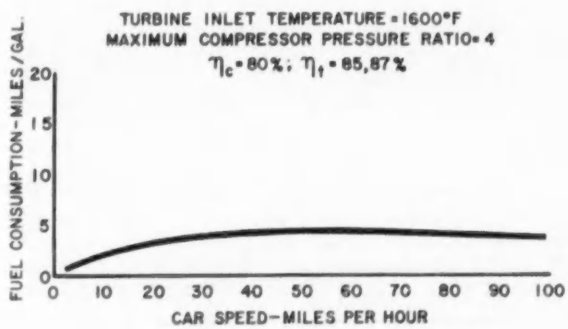
The remainder of the components are conventional or modified aircraft-type accessories and controls.

Awaits More Efficient Components

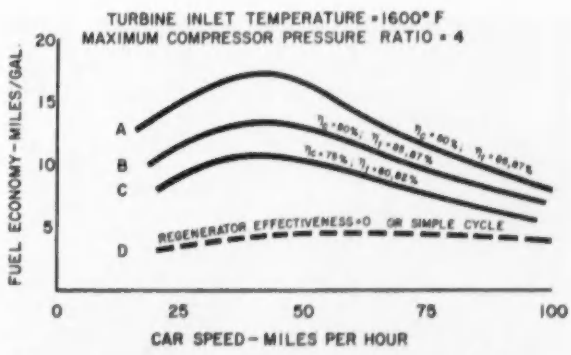
Research encourages Ford to accelerate development

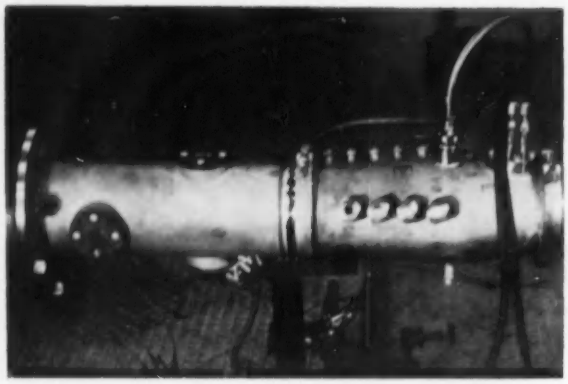
A. H. Beaufrere, Ford Motor Co.

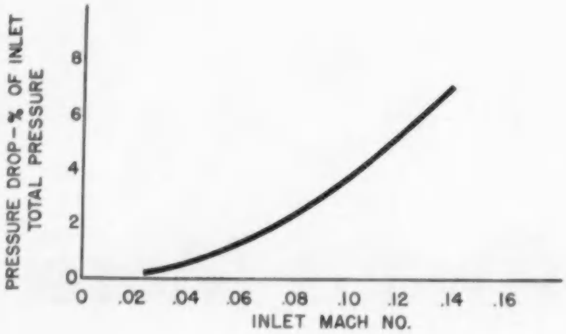
Based on paper "An Exploration of the Automotive Gas Turbine", presented at SAE Golden Anniversary Annual Meeting, Detroit, January 12, 1955.



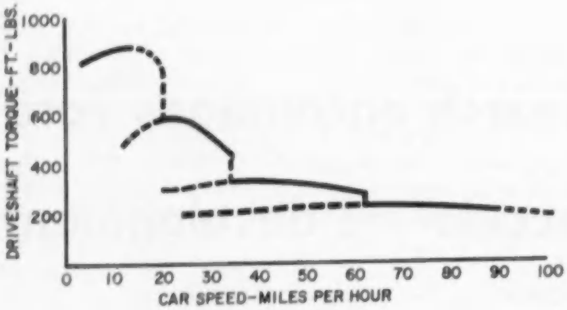
FUEL ECONOMY is very poor for a simple cycle gas turbine operating at the relatively low turbine inlet temperature of 1600 F and pressure ratio of 4:1—inspite of high component efficiencies. But, if a regenerator with high effectiveness is added, fuel economy is greatly improved, particularly in the 20 to 60 mph speed range. If regenerator effectiveness is reduced only 5% in the low flow range, the peak fuel economy would be reduced about 23%, as shown in curve B. Curve C is the same as B except that it shows the lower fuel economy resulting from five points lower compressor and turbine efficiencies.



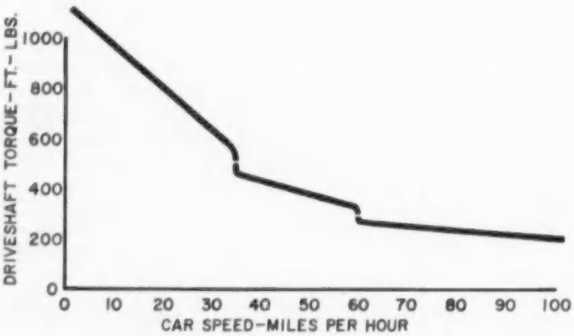




COMBUSTION CHAMBER has row of quartz windows so that flames may be viewed. This can-type burner was used to explore the wide air-fuel mixture limits of over 300 to 1 that are required in economical powerplants. The regeneration tends to force high burner inlet temperatures and correspondingly high inlet Mach numbers. With high Mach numbers, pressure loss increases rapidly, therefore burners must be designed very carefully.

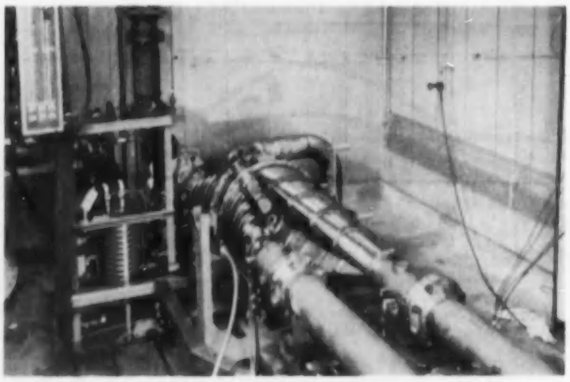


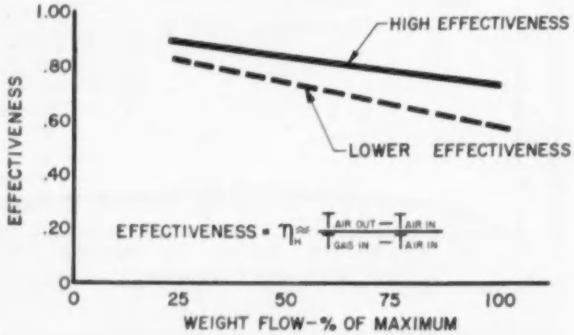
Piston engine



Gas turbine

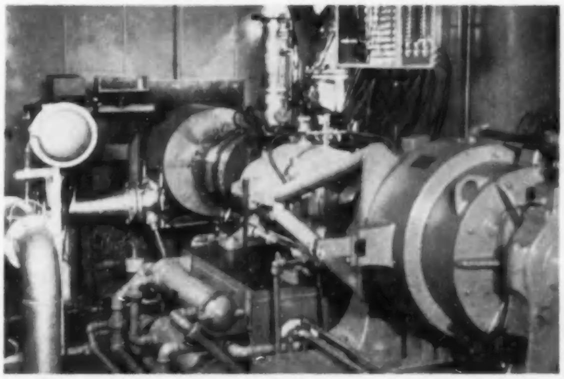
DRIVESHAFT TORQUE of a typical piston engine and a gas turbine installation are shown. The torque-speed characteristic of the gas turbine (rt.) is excellent and made possible by the free power turbine arrangement. At full power the compressor, being free to reach its maximum speed independently of car speed, can deliver high pressure gas to the power turbine, giving good high stall and low speed torque characteristics. Only a three-speed ratio transmission is required to match or better the torque of a reciprocating engine of equivalent power using a four speed ratio transmission.

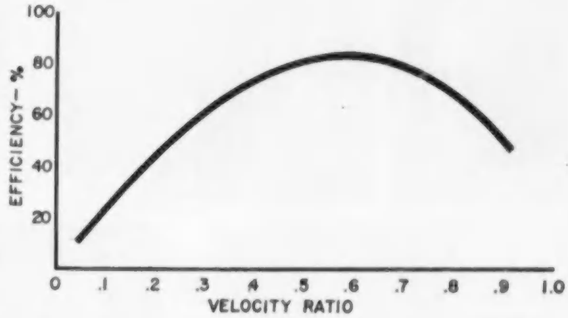




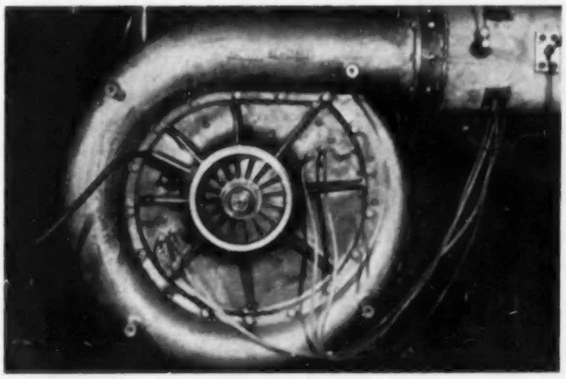
HEAT EXCHANGER is of the regenerative rotary matrix type. Counterflow is established with minimum turbulence (for test purposes only) by the long tapered ducts before and after the unit. The regenerator matrix consists of a porous metal disc which revolves at a very low speed through the

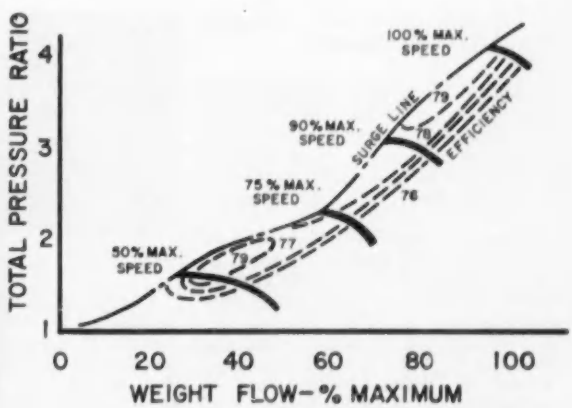
flowing gas and air streams. These streams are separated by a set of rotary face seals. The metal passage walls of the matrix soak up the heat from the turbine exhaust gas and continually return most of the compressed air. By reducing flow, effectiveness can be increased. It's possible to achieve high effectiveness in the limited space available in an automobile.





RADIAL FLOW TURBINE is tested on a dynamometer. The vertically mounted burner heats the air coming from the central laboratory supply. The radial flow turbine, fitted with variable area nozzles, was chosen to determine if high efficiency and broad range could be obtained in a simple, rugged, single-stage machine. A typical turbine performance curve plotted above is for the design nozzle position.





CENTRIFUGAL COMPRESSOR has a probe, mounted radially on the shroud near the inlet, which measures running clearance within a few thousandths of an inch. The associated circuit shows the instantaneous clearance of each blade, by measuring the change in capacitance of the air gap between rotor and stator. Test results show the high pressure ratios which can be obtained with high efficiency in a small, single stage gas turbine. Broad range is evident from the flatness of the speed lines, indicating that flow can be increased from surge with little reduction in pressure ratio or efficiency. Automotive gas turbines must be efficient throughout the power range.

(Paper on which this abridgment is based is available in full in multilithographed form from SAE Special Publications Department. Price: 35¢ to members, 60¢ to nonmembers.)

About SAE Members

CARL F. NORBERG was elected president of the Electric Storage Battery Co. at a recent meeting of the board of directors. He has been serving with Electric Storage Battery since 1943, holding the positions of vice president in charge of manufacturing, director, and executive vice president. He has been an active member of many organizations and societies as well as SAE.


Norberg


Cobb

EDWARD S. COBB, since 1947 a staff editor of McGraw-Hill's **Product Engineering** magazine, has joined the Public Relations Department of American Machine & Foundry Co. as technical information manager.

HARRY B. KNOWLTON has retired from his position as chief engineer, Materials Engineering with International Harvester Co., Chicago. He plans to continue his activity in SAE and will retain the chairmanship of Iron & Steel Technical Committee Division VIII—Boron steels.

ROBERT E. GROSS, president and board chairman of Lockheed Aircraft Corp., has been elected president of the Institute of the Aeronautical Sciences for 1955. He succeeds **J. L. ATWOOD**, president of North American Aviation, Inc.

Among the vice presidents elected are: **T. CLAUDE RYAN**, president of Ryan Aeronautical Co.; **EDWARD R. SHARP**, director of Lewis Flight Propulsion Laboratory of the National Advisory Committee for Aeronautics; and **EDWARD C. WELLS**, vice president—engineering, Boeing Airplane Co.

CHARLES H. COLVIN, president of Colvin Laboratories, was elected treasurer.

VICE-ADMIRAL U.S.N. (CC) (RET.) EMORY SCOTT LAND has become director and consultant for General Dynamics Corp. in Washington, D. C. He had been serving as president of the Air Transport Association in Washington.

BERNICE HARRIS, previously analyst-engineer with Chemical Projects Associates of New York, is now senior market analyst, Industrial Sales Department, Colgate Palmolive Co. in Jersey City.

PAUL A. MILLER has been named general manufacturing manager of Ford Motor Co.'s Parts and Equipment Manufacturing Division. He was manager of manufacturing engineering of the division. Miller came to Ford in August of last year from the Leece-Neville Co., where he was vice-president. He currently is SAE vice-president for Production.


Miller


Kuhn

TERRY W. KUHN has been elected executive vice president of Bohn Aluminum & Brass Corp. He is also a member of the board of directors of Reo Motors, Inc., subsidiary of Bohn Corp. Kuhn had been vice president in charge of sales for Bohn.

JOHN BURNS has joined John E. Wolf Co., Oklahoma City, as district manager of the New Orleans and Houston area. He had been service and parts supervisor for Turbiville Motors of Houston.

H. B. BARTLETT, general manager of the Parish Pressed Steel Division, Dana Corp., has been appointed vice president of the Dana Corp. He has been with the corporation since 1937, becoming general manager of Parish in 1954 and will continue those duties while serving as vice president.

WILLIAM R. BECKERLE, formerly of the SAE staff, has been named eastern district sales engineer of Weston Hydraulics, Ltd. He will be located in the New York area and will cover the territory east of the Mississippi River. At SAE, Beckerle served as staff engineer with aeronautical technical committees. He coordinated the activities of SAE committees with those of industry and government groups. He worked with SAE aeronautic groups such as the Hydraulic and Pneumatic Equipment Committee, the Electrical Equipment Committee, and the Fuel and Oil Systems Committee.

Before coming to SAE, he was associated with the engineering department of Wright Aeronautical in various capacities. He is a graduate in mechanical engineering from the University of Illinois.


Beckerle


Houser

COL. P. L. HOUSER has been elected president of the Metal Cutting Tool Institute of New York. He was general supervisior of manufacturing standards research, International Harvester Co., Chicago.

Houser has been one of SAE's representatives on Committee B5—Standards for small tools and machine tool elements—of the American Standards Association. Until December, 1954 he was chairman of that committee.

CHARLES S. MOTT, a director of General Motors Corp. since 1913, has been honored with the title "Big Brother of the Year." He was cited for the establishment of the Flint Youth Bureau which helps combat juvenile delinquency by recruiting young adult volunteers to help fatherless boys solve their problems. He has also cooperated with youth activities through the Mott Foundation.

JAMES H. COOLIDGE, vice president—Finance, Thompson Products, Inc., is the new national president of the Motor & Equipment Manufacturers Association. Coolidge, also a director, previously had served as vice president on the manufacturers' group.

W. L. GROTH has been named director of public safety for the city of Richmond. Capt. Growth has been safety engineer in the Virginia Department of State Police for many years. He is an active force in SAE Richmond Section and is a member of the SAE Lighting Committee.

LELAND D. COBB, manager of research and development of the New Departure division of General Motors Corp.; **WILLIAM H. MILLETT**, special products department of Carbide and Carbon Chemicals Co., division of Union Carbide and Carbon Corp.; and **ALBERT WILLI, JR.**, assistant chief engineer of Federal-Mogul Corp., were speakers at Oklahoma A&M College at the first annual lubrication conference presented jointly by the American Society of Lubrication Engineers and A&M's School of Mechanical Engineering.

IGOR I. SIKORSKY, engineering manager of the Sikorsky Aircraft Division of United Aircraft Corp., won the 1955 James Watt International Medal. This medal is one of the world's top honors in mechanical engineering.

The British Institution of Mechanical Engineers makes the award every two years on the birthday anniversary of James Watt, inventor of the high pressure steam engine.

HERBERT CLARK, managing director of Clifford Aero & Auto, Ltd., Birmingham, England, is located at the St. Regis Hotel in New York. His visit to the States, lasting from Jan. 24 to the middle of March, will include the introduction of the Clifford two-wheeled cultivator.

THOMAS F. COWLEY has joined the export division of Chrysler Corp., Detroit, Mich., as consulting engineer. He had formerly served as automotive engineer with Libby, McNeill & Libby, Honolulu, Hawaii.

News From Ford


Breech


Crusoe


Harder

Announcement of important appointments in the executive staff of the Ford Motor Co. has been made by **HENRY FORD II**, president.

ERNEST R. BREECH, formerly serving as executive vice-president of the company, has been elected to the newly created post of chairman of the board. He will continue to share the basic management responsibilities and decisions of the company.

Breech has been associated with Ford since 1946, serving as executive vice-president. As alternate chief executive officer, he will be vice-chairman of the Executive Committee and will continue as chairman of the Administration Committee.

LEWIS D. CRUSOE will be executive vice-president in charge of the three automotive divisions of the company. He had served as vice-president and general manager of the Ford Division.

D. S. HARDER, who was vice-president in charge of manufacturing, has been elected executive vice-president in charge of the company's three basic manufacturing groups.

CLYDE H. McMILLAN has accepted the position of assistant maintenance metallurgist with United States Steel Co., Gary Sheet & Tin Mill. He had been assistant manager of Motor Fire Apparatus Sales Engineering for American LaFrance Foamite Corp., Elmira, N. Y.

RICHARD W. RUPERT, formerly test engineer for Pratt & Whitney Aircraft Co., is now supervisor of R & H Corp., New Kensington, Pa.

PHILLIP E. CHURCHMAN is now on special assignment for the Ford Motor Co. plant in Louisville, Ky. He had been assistant general superintendent in the Ford Kansas City Aircraft plant, Claycomo, Mo.

ROBERT E. ALLEN, vice president of Precision Rubber Products Corp., was named president of the "O" Ring Sub-Division of the Rubber Manufacturers Association. He has been active in the organization for many years.

L. M. K. BOELTER, dean of the College of Engineering at the University of California at Los Angeles, has been appointed to the Los Angeles City Planning Commission by the mayor. Before joining UCLA Boelter was a member of the engineering faculty on the Berkeley campus from 1919 to 1944.


Boelter


Jung

J. P. JUNG will serve as regional manager—Southeastern Region, for Cummins Engine Co. His headquarters will be in Atlanta, Georgia. He served four and one-half years as assistant regional manager—Great Lakes Region at Cleveland, and for more than a year in the same capacity in the Southwest Regional Office at Los Angeles.

ANDREW C. McDERMOTT, previously stress analyst for Comprehensive Designers, Inc. of Philadelphia, is now serving in the same position with Consultants & Designers, Inc. of New York.

BERNARD T. NOVY is now design group leader, Engine, Transmission & Final Drive at the Cleveland Tank Plant of Cadillac Motor Car Division, General Motors Corp. Previous to this appointment he was senior designer at the tank plant.

CHARLES R. STAUB, chief engineer of Michigan Tool Co. since 1936, has been named staff consultant. He joined Michigan Tool in 1929 and has pioneered in the development of modern gear production methods and machines.


Staub


Beier

KURT A. BEIER, formerly chief engineer of the Schwitzer-Cummins Co., Indianapolis, Ind., has been appointed to the position of vice-president in charge of engineering and research.

C. W. La PIERRE has become vice-president in charge of General Electric Co.'s Atomic Energy and Defense Products Group, umbrella organization over GE's Aircraft Gas Turbine, Aeronautic and Ordnance Systems and Atomic Products Divisions. He will also continue in his former position as general manager of the Aircraft Gas Turbine Division.

SHELDON D. LINDEN has moved to the General Motors Styling Section in Detroit, Mich., where he is serving as special projects engineer. He was assistant chief engineer in the Cadillac Motor Car Division, Cleveland Tank Plant.

JOHN F. CREAMER has been appointed a member of the Advisory Board on Vocational and Extension Education, Board of Education, City of New York. Creamer is president and treasurer of Wheels, Inc., of New York. He has also been elected president of the Motor and Equipment Wholesalers Association. The MEWA is an international trade group of automotive wholesalers, with headquarters in Chicago.


Creamer


Stranahan

R. A. STRANAHAN, JR. has become president of Champion Spark Plug Co. in a major alignment of executive responsibility. He assumes the position of his father, **R. A. STRANAHAN, SR.**, who has retired.

Also affected in the realignment are **O. C. LEIGHTY**, who has been elected vice president and will continue in his capacity as sales manager, and **HARRY F. DAVIS**, who has been appointed equipment sales manager.

CLYDE MILTON RICE is now an advisory engineer, Rolls Royce Engines, for Westinghouse Electric Co., Aircraft Gas Turbine Division. He had been project engineer with Wright Aeronautical Division of Curtiss-Wright Corp.

B. D. CLAFFEY has accepted the position of director of research and development and general manager of the Ohio Malleable Division of Dayton Malleable Iron Co. He had served as president and general manager of Acme Aluminum Alloys, Inc., also of Dayton.

FLOYD L. MILES is now associated with Valley States Oils, Inc. of Memphis, Tenn. as executive vice-president and general manager. He had been director, Bulk Petroleum Sales, for Consumers Co-operative Association in Kansas City.

C. FAYETTE TAYLOR, professor of automotive engineering, Massachusetts Institute of Technology, will be lecturing on internal combustion engines at the Delft Technical Institute, Delft, Holland for the spring term under a Fulbright lectureship.

Taylor also has been scheduled to speak at the International Internal Combustion Engine Congress at Scheveningen, the Hague, Netherlands, on May 25.

Also speaking at the congress will be **GUSTAV GOLDBECK** and **FERNAND PICARD**. Goldbeck is the assistant to the management of Klockner-Humboldt-Deutz AG. Picard is director of studies and research, Regie Nationale des Usines Renault.

DONALD G. BAY has taken a position as project engineer in the Gas Turbine Division of Continental Aviation and Engineering Corp. He had served with Reo Motors, Inc. as head of the experimental laboratory of the Lawn Mower Division.

THOMAS J. AULT is now president and general manager of the Detroit Gear Division and the Long Manufacturing Division of Borg-Warner Corp. He had been vice president and purchasing agent of Warner Gear Division.

STUART H. HAHN has become engineering specialist in the newly formed Mechanical Development Section of the Electronic Defense Laboratory, Mountain View, Calif., a division of Sylvania Electric Products, Inc. He has been engineering consultant and was formerly chief mechanical engineer with Dalmo Victor Co., San Carlos, Calif., with whom he has been associated for the past seven and one-half years.


Hahn


Knapp

W. H. KNAPP has been appointed to the post of commercial manager for the Shell Oil Co.'s Chicago area. He had been assistant manager—Industrial Products for Shell in Chicago.

NORMAN G. SHIDLE, editor of SAE Journal, was the dinner speaker at a two-day meeting of the University of Wisconsin's Technical Report Writing Institute. His talk on Jan. 27 at Madison, Wis., urged report writers to state clearly the main idea of the report at the beginning.

EUGENE LAAS has joined the Nuclear Engine Project, Pratt & Whitney Aircraft Co., East Hartford, Conn. as senior test engineer. He had been project engineer for Lee Co., Westbrook, Conn.

IRVING B. OSOFSKY has joined the Cornell Aeronautical Laboratory, Buffalo, N. Y. as aeronautical research engineer. He had served with Thompson Products, Inc. as engineer in the development engineering department, Jet Division, Willoughby, Ohio.

G. D. SIMONDS has been elected vice-president-engineering of the Four Wheel Drive Auto Co. He has been with Four Wheel Drive 26 years and has been serving as chief engineer since 1948.

Simonds

Saunders

LAWRENCE P. SAUNDERS, consulting engineer, Carmel, Calif., has been honored with an honorary Doctor of Philosophy degree in Science by St. Andrews University College of London. The degree was awarded to Saunders for his work in heat control, both for private industry and the government.

Saunders has been engaged recently in a consulting capacity specifically with reference to heat transfer problems for a leading organization on the West Coast and in the East.

H. PETER KAREN is now associated with the Stratos Division of Fairchild Engine & Airplane Co., Bayshore, Long Island as project engineer. With Solar Aircraft Co. of San Diego, Calif., he had served as design engineer.

JOHN M. O'BRIEN has joined Ryan Aeronautical Co., San Diego as group engineer, Jet Engine Components Group, Production Liaison Section, Engineering Division. He had been supervisor of Test Engineering, Chrysler Jet Engine Plant, Chrysler Corp.

Wicklatz

Peterson

EDWARD G. WICKLATZ is now manager of Alemite and instrument engineering for Stewart-Warner Corp. in Chicago. His appointment came with the resignation of **DAVID C. PETERSON** as vice president and director of engineering and manufacturing.

JOSEPH GESCHELIN, Detroit editor, **Commercial Car Journal**, presented a lecture on current and future mechanical developments in motor trucks at the annual fleet operators' seminar at Purdue University on Feb. 11.

JOHN P. GATY, vice-president-general manager of Beech Aircraft Corp. of Wichita, Kansas, has been elected chairman of the Aircraft Industries Association of America, Inc. He has also been elected to the AIA board of governors, where he will represent the views of utility plane and engine manufacturers.

JOSEPH C. FIREY is now assistant professor of mechanical engineering at University of Washington. He had served as research engineer for the California Research Corp., Richmond, Calif.

R. W. BRICK, formerly purchasing agent for Solar Aircraft Co., has become secretary-treasurer of the Purchasing Agents' Association of Los Angeles. He is also serving as editor and manager of **Southwestern Purchasing Agent.**

JOHN POLOMSKI has been appointed chief engineer of the Products Development Laboratory of Borg-Warner Corp. He joined the Products Development Laboratory in 1952, supervising experimental work on automatic transmissions.

J. HOWARD PILE has edited a "Service Station Flat Rate Manual," responding to requests from service station operators. Pile was formerly chief of the Automotive Section (Service Trade Branch) of the Office of Price Stabilization of the U. S. government, and is now the writer of the column, "In The Service Bay," for **The Gasoline Retailer.**

ROY E. MARQUARDT, president of Marquardt Aircraft Co., Van Nuys, was the guest speaker at the meeting of the Cleveland-Akron Section of the American Rocket Society in Cleveland. His talk, entitled "Prelude to Power," traced his company's successful development of the subsonic ramjet engine.

PAUL G. RACICOT has moved to Van Nuys, Calif., where he will serve as plant engineer with Pax Metal Corp. He had served in that position with Oro Mfg. Co. in Adrian, Mich.

LLOYD D. SMITH is now a design engineer with Beech Aircraft Corp., Wichita. He was previously with Temco Aircraft Corp. in Dallas.

THOMAS LINDER, JR. is now associated with Chandler-Evans Division of Niles Bement Pond Co., West Hartford, Conn. He had been staff advisor to the assistant vice-president, Operations, for Delta-C&S Air Lines, Municipal Airport, Atlanta, Ga.

Students Enter Industry

STANLEY D. ADKINS (California State Polytechnic College '54) has joined Barium Products, Ltd. of Modesto, Calif., as junior mechanical engineer. He was chairman of the SAE Student Branch at California State during 1953-54 and won the Mac Short Award from the Southern California Section in 1954.

ALAN BRUCE CLARKE (Parks College of Aeronautical Technology '52) is now with North American Aviation, Inc. of Columbus, Ohio, in analyst production development.

ROBERT L. FRANZEN (Colorado University '50) is now associated with Horning-Cooper, Inc. as an engineer.

STANLEY F. KING (General Motors Institute '54) is serving as project engineer in the Pontiac Motor Division, Power Development Section, General Motors Corp.

KEITH A. KREUL (University of Wisconsin '51) has joined Fairbanks-Morse & Co. of Beloit, Mich. as junior engineer.

ALFRED M. MARQUEZ (California State Polytechnic College '54) is now an engineer with Kimball Mfg. Corp. in San Francisco.

ROBERT L. SOMMERVILLE has accepted the position of general sales manager of the automotive division of the Electric Storage Battery Co. He had been assistant sales manager since 1948. Sommerville was president of the Association of American Battery Manufacturers during 1952 and 1953 and continues to serve as a member of the board of directors.

Sommerville Smith

CHESTER A. SMITH has been appointed general manager of the Automotive Transportation Co. He had been serving as regional director, Fleet Section of General Motors Corp. in New York.

LEO F. DONNELLY has joined Mack Mfg. Corp. as manager of the Experimental Division. He had been associated with Ford Motor Co., Dearborn, Mich., as project engineer in the Truck Development Section.

WILLARD SCOTT SMITH is now associated with the Petroleum Maintenance Co. as chief engineer. He was previously connected with the Wilshire Oil Co., Inc.

JOHN M. OLSON is now associated with Rockford Clutch Division, Borg-Warner Corp. as design engineer. He had served in the same position with John Deere Dubuque Tractor Works.

R. K. CHRISTIE has become vice president in charge of Research and Engineering for Champion Spark Plug Co. of Toledo. He had been director of research since 1946.

Christie Bright

R. S. BRIGHT has been appointed to the executive staff of the Dodge Division, Chrysler Corp. In addition to the new executive assignments, Bright will continue his administrative direction of the three Dodge plants in Indiana.

BEN F. HOPKINS has resigned as honorary chairman of the board of Clevite Corp. He was one of the four founders of the corporation in 1919. He has been serving as honorary chairman of the board since 1951.

BEN W. GEDDES has been appointed section head in the Esso Research and Engineering Co. He will have charge of the Marketing Technical Services in the Products Research Division.

L. A. SELIN has been promoted to the position of sales manager for Eaton Mfg. Co., Cleveland. He has been assistant sales manager of the company since 1953.

MAX J. TAUSCHEK, previously manager, Engine Laboratories, Thompson Products, has become chief engineer, Valve Division, Thompson Products, Inc.

J. R. ALMOND has been elected vice-president of the power brake division of Midland Steel Products Co. He had been chief engineer of the power brake division since 1937.

Almond Kampman

KENNETH W. KAMPMAN has been appointed to the New Products Department of Sherman Products, Inc., Royal Oak, Mich. In his new post he will be responsible for development of various new products for Sherman. He had been export sales administrator of the Wayne Division of Gar Wood Industries, Inc.

R. A. HINCHLIFFE has joined Canadian Pacific Airlines (Repairs), Ltd., Calgary, Alberta, Canada as engineer. He had served with Northwest Industries, Municipal Airport, Edmonton, Alberta as project engineer.

JOHN W. TENHUNDFELD has become an engineering assistant with the General Electric Co., Cincinnati, Ohio. He was previously a design analyst with the Ford Motor Co.

ROBERT H. SWEENEY has become vice-president of New Castle Motors, Inc. New Castle, Pa. He was previously with Buick Youngstown Co., Youngstown, Ohio.

JAMES A. MILLER has been appointed development engineer for the Transmission Division of Clark Equipment Co. Prior to his association with Clark, he was in charge of transmission design and power-shift transmission development for the products development laboratory of the Borg-Warner Corp. and for the Ford Motor Co.

Miller Strohman

H. A. STROHMAN, assistant regional manager, Eastern Region, has been transferred from his previous headquarters in New York City to the new Middle-Atlantic office of Cummins Engine Co., Inc., at Harrisburg, Pa.

LEO M. DARTS is now western district manager with Chardon Rubber Co. of Chardon, Ohio. With Ball Bros. Co., Inc. of Munice, Ind., he had served as Detroit district sales manager.

LEONARD F. B. REED, formerly vice-president of the Autocar Sales & Service Co., Chicago, is now Autocar regional manager, White Motor Co., Autocar Division.

HAROLD G. SMITH, formerly executive engineer in charge of all engine design for the Buda Co., Harvey, Ill., is now an engineering consultant located in Baldwin, Mich.

EUGENE S. WITCHGER is now general sales manager of Schwitzer-Cummins Co., Indianapolis, Ind. He had formerly served as sales manager of the Pump Division, Eaton Mfg. Co., Detroit.

Witchger Davis

HARRY DAVIS has been promoted to the post of manager of equipment sales for Champion Spark Plug Co. He will continue to maintain his headquarters in Detroit where, since 1951, he has been district manager of equipment sales.

Obituaries

RICHARD O. MEAD

Richard O. Mead, former vice-president and director of Herbrand Division, Bingham-Herbrand Corp., Toledo, died recently.

He had started in industry as sales manager for American Wood Rim Co. of Onaway, Mich. Later he served as sales representative for Allerding Products Co. and Herbrand Co. He also acted as manufacturers' agent in the General Motors Building in Detroit. In 1933 he became vice-president of Herbrand Co., which is now Herbrand Division of Bingham-Herbrand Corp.

Mead has been prominent in SAE activities and has also been active in the American Ordinance Association, the Automobile Old-Timers, the Boys Club of Detroit, and Onaway Masonic Lodge.

ALVIN G. TANNER

Alvin G. Tanner, district automotive engineer for Socony-Vacuum Oil Co., Inc., Hartford, Conn., died Nov. 10.

During his long engineering career, Tanner has served in various capacities with companies such as Locomobile Co. of America, Standard Oil Co. of New York, and Socony-Vacuum Oil Co. He had been district automotive engineer in Hartford since 1945. In the early part of his career he acted as government engineer inspector at the Erie Proving Ground.

Tanner was born on May 3, 1889 in Pittsfield, Mass. and attended Union College in Schenectady, N. Y.

HARRY W. BOORD

Harry W. Boord, special representative of American Oil Co. for 22 years, died Nov. 13 at the age of 61. Boord studied automotive engineering at Carnegie Institute of Technology and worked with various certified public accountants, majoring in corporation accounting. During World War I, he enlisted in the 26th Yankee Division and saw action in all major engagements.

Boord was chairman of the Pittsburgh Section in 1941-42. During his administration, the Pittsburgh Section "Broadcaster," a monthly magazine of about 20 pages carrying news of members, was organized. He felt that the publication would increase members' interest in the local SAE Section. Unfortunately when World War II came along the "Broadcaster" had to be discontinued. During his term as chairman, Boord was the driving force behind the purchasing, by the Pittsburgh Section, of a station wagon that was donated to the Civil Defense Patrol.

RAYMOND S. SADDORIS

Raymond S. Saddoris, director of Quality, Manufacturing Staff, A. O. Smith Corp., Milwaukee, died Nov. 13. He was 56.

Saddoris had served with A. O. Smith since 1921. He started his career with that company as draftsman and served thereafter as assistant chief inspector, chief inspector, staff assistant to the vice-president in charge of manufacturing, and director of Quality on the manufacturing staff.

He held Senior Membership in the American Society for Quality Control and presented papers on quality control before SAE members.

GERALD R. McDONALD

Gerald R. McDonald (J '54), development technician and instructor with Caterpillar Tractor Co., died Sept. 30. He was 27.

McDonald had been a Student Member at Bradley University, from which he graduated with a B.S. in Mechanical Engineering in 1952.

HAROLD R. UHRICH

Harold R. Uhrich, propeller design engineer of S. Morgan Smith, Inc., York, Pa., died recently.

Uhrich was born in Millersville, Pa. and attended Pennsylvania State College. He received a B.S.M.E. from Penn State in 1933 and the degree of Aeronautical Engineer from New York University in 1937. While working for his degree at New York University, he was a Student Member of the Institute of Aeronautical Sciences.

Among the positions which he held are engineer, Sensenich Brothers Propeller Co., Lititz, Pa.; chief engineer with Sensenich; aeronautical engineer with Platt Le Page Aircraft Co.; chief engineer, Koppers Co., Inc. Aeromatic Propeller Department; and propeller design engineer with S. Morgan Smith, Inc.

JAMES SCRIPPS BOOTH

James Scripps Booth, Sun House, Comstock Hill, Silvermine, Norwalk, Conn., died recently. He had been in retirement.

Booth joined SAE in 1915, at which time he was vice-president of Scripps Booth Co., Detroit. Previously, he had been absorbed in motor design. He had served with the Hupp Motor Car Co.; had developed a large two-wheel car with an eight cylinder motor; spent time in Europe in body design research with Lozier Motor Co.

Since 1915 Booth has been employed independently in the engineering profession as artist, engineer, and freelance designer.

JAMES T-B BOWLES

James T-B Bowles, petroleum technologist with Crown Central Petroleum Corp., Baltimore, died Nov. 28. He was born in Paris, Ill. on Mar. 20, 1882.

Bowles had served with Crown Central since 1925 as petroleum technologist. Previous to joining that company, he served in the U. S. Army as a sanitary engine expert, was a member of the Isthmian Canal Commission, Panama, and was petroleum technologist with Tide Water Oil Co.

Bowles was a member of the American Society for Testing Materials, and the American Chemical Society, and was associate member of the American Society of Civil Engineering. He received a B.S. from the University of Michigan in 1907.

JOSEPH POULIN

Joseph Poulin, founder, president and general manager of Asbestonos Corp., Ltd., Montreal, died Jan. 8, 1955. He was 73.

Poulin started in business for himself in 1914 as a concrete contractor, then as a prospector of asbestos mines and manager of a woolen mill. He founded Asbestonos Corp. in 1920 and transformed wool weaving machines for the purpose of weaving asbestos fibres.

With the assistance of his sons,

Poulin transformed his industry into a war production plant during the last war; acquired a molybdenite mine in Quyon, Que. and founded Allied Machine Works, Ltd. His reputation as an industrialist is better known as manufacturer of asbestos products, due to the transformation brought about to his machines.

He was a member of the Knights of Columbus, Board of Trade, Club Renaissance of Quebec, and Royal Automobile Club.

EVAN H. WRIGHT

Evan H. Wright, 17560 Avilla Rd., Birmingham, Mich., died Dec. 25. He had been a member of SAE since 1917.

Wright started in as draftsman with Wright-Martin Aircraft Co. and in 1918 served as designer for several companies, including Packard Motor Car Co., Ford Motor Car Co., and Dow Chemical Co. He became engineer with Ford in 1938 and took charge of the Bus Engineering Department in 1948. He continued in this capacity until his retirement in 1954.

MATTHEW C. KUEPFER

Matthew C. Kuepfer, director and vice-president in charge of production for Hercules Motors Corp. in Canton, Ohio, died Sept. 26.

Kuepfer was born in Canton and attended commercial schools there. He started his engineering career as an apprentice with Hercules.

During the 35 years that he served with Hercules, Kuepfer held the posts of apprentice, factory manager, vice-president in charge of production, and director.

DAVID N. MILLER

David N. Miller, 58, branch manager of the Reo Motors, Inc., Cincinnati, died Dec. 9, after a short illness.

Miller had been associated with the automotive industry for more than 30 years. He held positions with Trailmobile, Inc., Mack Mfg. Corp., Autocar Sales & Service Co., and Reo Motors in his career as representative and branch manager. He had been Cincinnati branch manager for Reo during the past four years.

Besides his association with SAE, Miller was a member of the Cincinnati Executives Club.

ARTHUR POLTMANN

Arthur Poltmann, chief process engineer, Wright Aeronautical Corp., died July 1. He was born in Paterson, N. J. on Nov. 1, 1892.

Poltmann had been with Wright ever since he started in industry. He joined as trouble shooter in 1931 and thereafter served as process engineer, foreman, assistant production engineering manager, and chief process engineer.

He was a Senior Member of the American Society of Tool Engineers.

WILLIAM N. HINDS

William N. Hinds, president and treasurer of Hinds & Associates, Inc. of Kansas City, Mo., died Nov. 13. He was 59.

Hinds started in business as a sales representative with Mason Tire & Rubber Co. in 1924. He moved to Hudson Motor Car Co. in 1927, where he served as regional manager. From 1932 to 1940 he served as district manager with Ford Motor Car Co., owned Marion Top Co. of Indianapolis, and was district manager for Willys-Overland, Inc.

He joined the faculty of Armored School in Fort Knox, Ky. as senior instructor of the automotive department in 1941 and served in that post until 1953 when he became president of William N. Hinds & Associates.

CARL F. STERBUTZEL

Carl F. Sterbutzel, age 50, died of heart ailment on Nov. 4. Sterbutzel was a prominent business man and civic leader in Connellsville, Pa. For the past 25 years, he owned a service station and tire business. In addition to his SAE membership, he also was a member of the Pennsylvania Motor Truck Association and the Western Pennsylvania Bus Association.

Sterbutzel was a gun enthusiast and for many years held a membership in the National Rifle Association. A crack shot, he was named to the 20-man team representing the United States in a shooting contest held in 1953 with members from Great Britain. Membership on the international group is regarded as a high honor. He served as a director of the N.R.A. for four years and was a past president and director of the Pennsylvania State Rifle Association.

Sterbutzel was a Kiwanian for 22 years, past president of the Connellsville Chamber of Commerce, and very active in Boy Scout work.

ARTHUR A. AYMAR is now project engineer with Stratos Division, Fairchild Airplane & Engine Corp. in Bayshore, N. Y. He was assistant project engineer with Hamilton Standard Division of United Aircraft Corp.

ROBERT W. BACHMANN has joined Twin Disc Clutch Co., Hydraulic Division in Rockford, Ill., as application engineer. He had been trainee engineer with Cummins Engine Co., Inc. in Columbus, Ind.

NEILS C. BECK, program development engineer, has been promoted to assistant manager of program development at Armour Research Foundation of Illinois Institute of Technology.

JOHN A. NEWTON, Thompson Products, Inc., has been named factory manager of the Valve Division. He had been chief sales engineer of the same division.

W. E. BALL and **H. G. RAHN** have been transferred by the Dominion Rubber Co., Ltd., to Kitchener, Ontario. Ball, formerly assistant sales manager, is now manager of Automobile Tire Sales. Rahn, who was district supervisor, is serving as manager of Commercial Tire Sales.

HAROLD L. FLYNN has joined Harry W. Smith, Inc. of New York as account executive. He had been with Jones & Brakeley, Inc. as director of industrial press relations.

LEIGH K. LYDECKER has retired from his position as president of the Alox Corp. in New York. He is now a director of Maywood Chemical Works.

C. L. RYAN, previously secretary, treasurer of Springfield Machine & Stamping Co., Van Dyke, Mich., is now associated with Pullman Sales & Engineering Co., Detroit, Mich.

WILLIAM J. REID has joined Willard Storage Battery Co. of Australia Pty., Ltd., Sydney, as general manager. He had been salesman (Export) for ESB International Corp., New York.

JOHN DRAKE ROGERS has been promoted to the position of supervisor of jet engine studies with Westinghouse Electric Corp., Aircraft Gas Turbine Division. He had served as design engineer.

JACK L. GOCKEL is now research engineer with North American Aviation, Inc., Los Angeles. He had held the same position with Continental Oil Co. in Ponca City, Okla.

I. E. McWETHY is now research engineer for Crosley and Bendix Home Appliances Division, AVCO Mfg. Corp., Cincinnati. He had been chief development engineer with Admiral Corp., Galesburg, Ill.

GEORGE A. LUNDIN is now associated with Bucyrus-Erie Co. in Milwaukee as layout draftsman. He had served as service engineer with Le Roi Co., also of Milwaukee.

C. J. WERNER is now general manager of the Moraine Products Division, General Motors Corp. His previous position was manager of manufacturing for Delco Products Division, GMC.

J. R. MONTGOMERY is now owner and manager of Montgomery's Service Centre, Toronto, Can. He had served as service manager for Massey-Harris-Ferguson, Ltd. of Toronto.


Spencer


Rodgers

W. P. SPENCER and **W. L. RODGERS** have been named to a new district sales office of the National Motor Bearing Co., Inc., in Indianapolis. Both men were formerly associated with the Chicago district sales office.

I. W. RUGE has taken the position of national accounts representative with Pure Oil Co., Chicago. He had served as automotive research engineer for that organization.

E. F. NASON, formerly general sales manager with Elastic Stop Nut Corp. of America, has been named administrative assistant.


Anglim

JOHN ANGLIM, chief metallurgist of the American Motors Corp. Kenosha Plant, has retired after 42 years with the company. He had served as chief metallurgist since 1918. **WHITNEY SNYDER**, formerly assistant chief metallurgist, has been promoted to fill the position held by Anglim.

continued on page 108

Council Puts Charge of $1-to-members on SAE Handbook

● Beginning with 1956, a $1-to-members charge goes on SAE Handbook, as a result of SAE Council action at its January 14 meeting. Elimination of any possible waste circulation of this now-expensive volume was a chief basis for the action, discussion preceding the action indicated.

● With expenses on this 1000-page volume running about $115,000 per year, its publication has assumed a major place in the Society's budget. Consultation with members of the SAE Technical Board, Publication Committee, and Membership Committee prior to the Council meeting, brought a conviction that a certain number of copies were being distributed which did not actually serve the members who got them. . . . And every copy distributed and not used, now means $5 out of the funds available for useful services to members.

● It was Council's thought that the nominal charge of $1 would eliminate orders from those who have no actual use for the volume, yet not impede its availability to those who do.

● In 1955, there will be 19,000 copies of SAE Handbook printed, less than 3000 of which are likely to be sold—at $10 per copy to SAE members or to companies in which there is an SAE member, or at $20 per copy to non-members or to companies in which there is no SAE member.

Beginning with the 1956 SAE Handbook, the prices will be:

(a) One copy to each SAE member for .... $ 1.00

(b) Additional copies to SAE members or to companies in which there is an SAE member ... $10.00

(c) To non-members and to companies in which there is no SAE member $20.00

● Only the first of these items (that is, the charge of $1 to SAE members for their first copy) is different than at present.

1905 GOLDEN ANNIVERSARY 1955

Aeronautic Meeting

and Aircraft Engineering Display

and

Aeronautic Production Forum

	TECHNICAL SESSIONS & DISPLAY — HOTEL STATLER			HOTEL McALPIN
THEME	PROPULSION MONDAY, APRIL 18	AIR TRANSPORT TUESDAY, APRIL 19	MILITARY AVIATION WEDNESDAY, APRIL 20	AERONAUTIC PRODUCTION FORUM THURSDAY, APRIL 21
MORNING	Preview of Future Powerplants by British and American Experts Jet Stream and Weather Radar Auxiliary Power Source vs. Remote Drives Packaging Against Shock & Vibration —Part I	New Turbine Transports Noise Control—A Year's Progress Future Short-Haul Transports	Military Aircraft Developments What's Ahead for Helicopter Transportation? Suitability of Powerplants to Military Tactics	**Seven Simultaneous Panels:** Engineering Changes in the Competitive Market Automation—Its Effect on Manufacturing Methods Effect of Cost Reduction on Tooling Improving Factory Communication Efficient Quality Control Mfg. of Electronic Equipment Cost-Reduction Programs
LUNCH	*Toastmaster*—ROY T. HURLEY *Speaker*—F. C. CRAWFORD	*Toastmaster*—EARL D. JOHNSON *Speaker to be Announced*	*Toastmaster*—MUNDY I. PEALE *Speaker*—GENERAL BENJAMIN W. CHIDLAW	*Toastmaster*—G. F. CHAPLINE *Speaker*—HON. T. P. PIKE
AFTERNOON	Current Turboprop and Turbojet Powerplants Safety & Comfort in Aircraft Transportation Cooperative Engineering in the Jet Age Packaging Against Shock & Vibration —Part II	Future of Air Transportation—Golden Anniversary Panel Means of Decelerating Aircraft on the Ground	Military Transports for Assault and Cargo Use A Critical Look at Turbine Fuels & Lubricants Engine Design & Qualification—American & Foreign Practices	Continuation of Seven Simultaneous Panels Listed Above
			DINNER DANCE	

R. E. JOHNSON, *General Chairman*
SAE GOLDEN ANNIVERSARY AERONAUTIC MEETING

G. F. CHAPLINE, *Sponsor*
and
A. B. HEGNER, *Chairman*
for
SAE AERONAUTIC PRODUCTION FORUM

Aeronautic Meeting
April 18-20
Hotel Statler
New York

Production Forum
April 21
Hotel McAlpin
New York

1955 SAE GOLDEN ANNIVERSARY NATIONAL MEETINGS...

March 14-16
Production Meeting and Forum
Netherland Plaza, Cincinnati, Ohio

April 18-21
Aeronautic Meeting, Aeronautic Production Forum, and Aircraft Engineering Display, Hotel Statler and McAlpin Hotel, New York, N. Y.

June 12-17
Summer Meeting
Chalfonte-Haddon Hall, Atlantic City, N. J.

August 15-17
West Coast Meeting
Hotel Multnomah, Portland, Ore.

September 12-15
Tractor Meeting and Production Forum
Hotel Schroeder, Milwaukee, Wis.

October 11-15
Aeronautic Meeting
Aircraft Production Forum, and Aircraft Engineering Display
Hotel Statler, Los Angeles, Calif.

October 31-November 2
Transportation Meeting
The Chase, St. Louis, Mo.

November 2-4
Diesel Engine Meeting
The Chase, St. Louis, Mo.

November 9-10
Fuels and Lubricants Meeting
The Bellevue-Stratford
Philadelphia, Pennsylvania

1956 SAE National Meeting . . .

January 9-13
Annual Meeting
The Sheraton-Cadillac Hotel and Hotel Statler, Detroit, Michigan

SAE Section Meetings...

Atlanta—April 14

Ship-A-Hoy Restaurant. Dinner 7:00 p.m. Meeting 8:15 p.m. "The Application and Maintenance of Tapered Roller Bearings in Automotive Equipment"—Elmer Anderson, service manager, Timken Roller Bearing Co., Canton, Ohio.

Canadian—March 16

Royal York Hotel. Meeting 6:30 p.m. "Future Possibilities and Trend in Passenger Cars, Projected from the Last Fifty Years"—Maurice Olley, Director of Research and Development Section, Chevrolet Motor Division, GMC, Detroit. Golden Anniversary Meeting.

Central Illinois—March 21 and April 13 and 14

March 21—American Legion Hall, Peoria, Illinois. Dinner 6:45 p.m. Meeting 7:45 p.m. "Where Does A Graduate Engineer Fit In Industry"—Panel discussion with representatives of industry and students from the University of Illinois and Bradley University.

April 13 and 14—Pere Marquette Hotel. Earthmoving Industry Conference.

Cleveland—March 14

Manger Hotel, Cleveland. Dinner 6:30 p.m. Meeting 7:45 p.m. "Operations of the Strategic Air Command"—Major General Francis Griswald, Vice Commander of Strategic Air Command, Offut Field, Omaha, Nebraska. Golden Anniversary Meeting.

Chicago—March 21

South Bend Division. Hotel LaSalle, Bronzewood Room, South Bend, Indiana. Dinner 6:30 p.m. Meeting 8:00 p.m. "Abrasive Wear of Engines"—Dr. W. S. James, Vice-President, director in charge of engineering, Fram Corp. Technical Chairman: T. A. Scherger, chief powerplant engineer, Studebaker-Packard Corp., South Bend, Indiana.

Dayton—March 16

Inland Manufacturing Division. Dinner 7:00 p.m. Meeting 8:00 p.m. Plant Tour of New Engineering Building and Laboratory Facilities.

Detroit—March 28 and April 11

March 28—Rackham Educational

Memorial. Dinner 6:30 p.m. Meeting 8:00 p.m. "Urgent Need for Basic Principles of Automation"—Edward H. Kelley, general manufacturing manager, Chevrolet Motor Division, GMC. Dinner Speaker: Edward A. Gleason, Bureau of Customs.

April 11—Dinner Meeting and Tour. Dinner at Commodore Perry Hotel, Toledo, Ohio. "Wrap-Around Windshields"—Dr. George B. Watkins, Libbey-Owens-Ford Glass Co. Toastmaster:—James P. Falvey, Electric Auto-Lite Co. Tour to be announced.

Metropolitan—March 16

Student Activity Meeting—New York University Auditorium. Meeting 7:45 p.m. "Gas Turbines"—Robert Marwood, field representative, Solar Aircraft and A. B. Beaufrere, manager, Gas Turbine Department, Ford Motor Co.

Mid-Continent—March 18

Bartlesville, Oklahoma. Meeting 7:30 p.m. "Trends in Farm Tractors and Fuels"—K. L. Pfundstein, head of Agricultural Engineering Department of Technical Service, Ethyl Corp., Detroit.

Mid-Michigan—March 21

Owosso City Club, Owosso, Michigan. Dinner 7:00 p.m. Meeting 8:00 p.m. "Fuel Injection for Passenger Car Engines"—Ernest K. Van Martens, Detroit Engineering Representative, American Bosch Corp. and Adolph Braun, staff engineer, Buick Motors Division, GMC, Flint, Michigan.

Milwaukee—April 1

Milwaukee Athletic Club. Dinner 6:30 p.m. Meeting 8:00 p.m. "Trends in Management"—Mrs. Lillian Gilbreth, Knapp Visiting Professor, University of Wisconsin, Madison, Wisconsin.

Mohawk-Hudson—April 12

Circle Inn, Lathams, N. Y. Dinner 6:45 p.m. Meeting 8:00 p.m. "New Techniques to Match Spark Plugs to Engines"—Richard C. Teasel, research engineer, Champion Spark Plug Co., Toledo, Ohio.

Montreal—March 21

Mount Royal Hotel. Meeting 7:45 p.m. "Power Cranes and Shovels"—E. A. Nix, Design Engineer, Dominion Engineering Co., Ltd.

Northwest—March 11

Stewart Hotel. Dinner 7:00 p.m. Meeting 7:45 p.m. "Piston Rings"—Melvin E. Estey, Chief Research Engineer, Perfect Circle Corp., Hagerstown, Indiana. 35 mm Colored Slides.

Philadelphia—April 13

Engineers Club. Dinner 6:30 p.m. Meeting 7:45 p.m. "Commercial Plastic Bodies"—Walter R. Herfurth, assistant to vice-president, United Parcel Service, New York. "Plastics For Trailer Bodies"—Stanley S. Wulc, Plastics Division, Strick Co., Philadelphia, Pennsylvania. Technical Chairman: Murray Simkins, Chilton Co.

St. Louis—April 12

Gatesworth Hotel. Dinner 6:30 p.m. Meeting 7:30 p.m. "Air Suspension"—D. J. LaBelle, New Development Engineer, General Motors Corp., Detroit.

Southern California—March 14 and April 4, 5, and 6

March 14—Rodger Young Auditorium. "Development in Gasoline Additives"—Leonard Raymond, Socony-Vacuum Oil Co. Golden Anniversary Meeting.

April 4, 5 and 6—Fuels and Lubricants Seminar—General Petroleum Auditorium, Los Angeles. Starting Time 7:15 p.m.

April 4—"Heavy Duty Lubricative Additives and Used Oil Evaluation"—Speakers: Dr. U. B. Bray and Ralph Faber. Technical Chairman: J. F. Snider.

April 5—"Passenger Car Fuel and Lubricant Problems"—Speakers: J. Brent Malin and C. K. Parker, Jr. Technical Chairman: Max Epps.

April 6—"Automobile Exhaust and the General Smog Condition of the Los Angeles Area"—Speakers: Dr. D. H. Hutchison, C. V. Kanter and Dr. W. L. Faith. Technical Chairman. Wallace Linville.

Syracuse—March 14

Museum of Fine Arts, Syracuse. "Passenger Safety in Automobile Crashes"—Edward R. Dye, Head, Industrial Division, Cornell Aeronautical Laboratories, Buffalo, New York.

Texas—April 8

Aircraft Production.

Texas Gulf Coast—March 24

San Antonio Division. "Engineering Features of 1954 Indianapolis Cars"—R. T. Jackson, Sales Engineer, Perfect Circle Corp., Hagerstown, Indiana.

Twin-City—April 13

Curtiss Hotel, Minneapolis. Dinner 6:45 p.m. Meeting 8:00 p.m. "Fuels and Combustion"—Speaker from Ethyl Corp.

Virginia—March 28

William Byrd Hotel. Dinner 6:30 p.m. Meeting 7:00 p.m. "Building Safety into Motor Vehicles"—Howard K. Gandelot, Engineering Staff, General Motors Corp., Detroit.

Washington—March 15 and April 12

March 15—Occidental Restaurant, International Room. Dinner 7:00 p.m. Meeting 8:00 p.m. "Bi-Metallics and Use in Diesel Equipment"—George T. Ladd, Chief Engineer, Al-Fin Division, Fairchild Engine and Airplane Corp., Farmingdale, Long Island.

April 12—"Test Results, Boeing 707"—George S. Schairer.

Western Michigan—March 15

Bill Stern's Steak House. Dinner 7:00 p.m. Meeting 8:00 p.m. "First 50 Years of SAE and the Engineer"—Robert F. Kohr, vice-president in charge of SAE Passenger Car Activity, Ford Motor Co., Detroit. Also a Film "To-morrow Meets Today". Golden Anniversary Meeting.

Williamsport—April 4

Moose Club Auditorium. Dinner 6:30 p.m. Meeting 7:45 p.m. "Next 25 years in Aviation Industry"—Val Cronstedt, Owner, The Val Dor Co.

SAE Annual Earthmoving Industry Conference

April 13 and 14 — **Hotel Pere Marquette, Peoria, Illinois**

Aspects of "Earthmoving" to Be Covered at Technical Sessions Include:

- ★ Highway Planning and Operation
- ★ Earth Compaction Methods
- ★ Military Angles of Construction Power
- ★ Tires, Shovels, and Air Compressors

Banquet on evening of April 13 will feature talk

"The Power of Ideas"

by Prof. Paul D. Bagwell

Head of Department of Communication Skills
Michigan State College

from the Sections

Twin City

Field Editor
R. V. Rosenwald
Dec. 20

16,500 FT-LB OF STRIKING ENERGY is developed by the new diesel pile hammer.

This section was honored to have two well known speakers talk on the diversified subjects of hydraulic equipment in diesel locomotives, diesel pile hammers and the evolution of outboard motors as related to automobiles.

The first speaker, S. H. Knight, supervisor of work equipment, Northern Pacific Railroad Co., presented highlights noting that the maintenance problems are becoming extremely acute because of the **lack of standardization of hydraulic equipment** as supplied by different vendors. Because the use of hydraulics in railroad equipment is still in its infancy, there is much to be done to make the overhaul and maintenance problems a practical matter.

Knight's second subject was equally as interesting. Diesel pile hammers were compared directly with the steam propelled type no longer being built. The new diesel hammer develops 16,500 ft-lb of striking energy, is simple in design with a minimum of parts, and can be operated by means of a single control line. A recent test of approximately 250 hr of operation showed no evidence of wear.

Lowell E. Haas, chief engineer of Scott-Atwater Mfg. Co., Inc., discussed the evolution of outboard motors as related to automobiles. The comparison was based on the different phases of the manufacture of automobiles: namely, make it work, make it reliable, make it pretty, make it quiet and make it so the women can operate it. The first three phases are already in evidence in outboard motors. The latter two started to put in an appearance in 1954 but will really come into their own in 1955. The new Scott-Atwater motors for 1955 will feature a very unique **spring snubbing system** which eliminates the engine vibrations normally picked up by the large surfaces of the boat.

Central Illinois

Field Editors
Y. M. Miller
E. E. Hanson
Dec. 27

EARTHMOVING EQUIPMENT IN GREENLAND has been observed in operation by J. M. Davies, director of research, Caterpillar Tractor Co., during his visit to Thule Air Force Base. Caterpillar eguipment is well liked because it is **rugged and easy to maintain and service.**

Thule is within 930 miles of the North Pole and therefore many unique problems were encountered in the construction of the base. The floors of buildings are insulated to keep them from melting the perma-frost and sinking into the frozen ground on which they are constructed. The lack of clay in the gravel makes roads hard to stabilize. Water is made by melting ice and is hauled in insulated tanks. Sanitation is a problem since sewers cannot be laid.

Field Editors
Y. M. Miller
E. E. Hanson
Jan. 24

TURBOCHARGING CAN DOUBLE AUTOMOTIVE ENGINE OUTPUT.

Rudolph Birmann, consulting engineer to De Laval Steam Turbine Co., discussed application of turbocharging to four-stroke-cycle engines. In correcting two beliefs long held by automotive engineers, he stated that it is possible to obtain fairly

From Section Cameras

Atlanta Jan. 3

REVIEWING THE EVENING'S EVENTS are (left) C. M. Larson, Sinclair Refining Co., and Section Secretary E. D. Troutman, Auto Electric Co. of Georgia. Larson spoke on the growing pains of the automotive and lubrication industries.

Atlanta Jan. 28

MARKING ATLANTA'S RISE TO SECTION STATUS with a visit is SAE President C. G. A. Rosen, who also helped the Section celebrate SAE's 50th Anniversary.

No. Calif.—South Bay Division Feb. 1

POINTING OUT a typical application on truck spindle to Roy Hundley, reception chairman (left), is Robert G. Strother of Magnaflux Corp. Looking on are (center right) William Adams, South Bay chairman, and (far right) R. P. Turner, Magnaflux field engineer.

constant bhp over a wide range of engine rpm. Also, turbocharged engines can respond to speed changes faster than naturally aspirated engines.

Successful application requires good intercooling, smooth manifolding, correct valve timing, and metals able to handle the high heat load along with correct matching of turbocharger and engine air inlet characteristics. The best match of engine and turbocharger is obtained with adjustable turbine guide vanes.

Reduction in the fuel consumption of 15 to 20% is possible. Intercooling reduces the heat load on the engine cooling medium and makes possible better combustion with an air excess.

Salt Lake

Field Editor
C. W. Dunbar
Jan. 17

VARIETY IS NECESSARY in gear oil types. The future trends in gear oils are toward the multipurpose type, but there are conditions that require even more e-p qualities. With the more active type required for high hp passenger cars, there is a diversity of requirements which indicates the need for separate types of gear oils to satisfy all automotive equipment.

S. R. Calish, Jr. presented these highlights in his discussion of "Automotive Gear Lubricants and Greases" before the Salt Lake Group. Calish, research engineer with California Research Corp., stated that it is expected that in the future more emphasis will be given to oils for anti-rust and anticorrosion protection gear-case assemblies.

As for trends in greases, he pointed out that new greases utilizing non-organic thickeners are gaining acceptance for specific applications. However, **high quality greases are continuing to be made from organic or soap thickeners.**

There has been some trend to oil lubrication of wheel bearings in truck equipment. It will be necessary, he added, to continue development of oil seals capable of withstanding the high temperatures resulting from the high speeds presently experienced in this equipment.

Buffalo

Field Editor
D. I. Hall
Dec. 14

AN AIRLINE IS A "LIVING ORGANIZATION THAT NEVER SLEEPS" according to Captain Fred H. Shaw, assistant director of flying operations at American Airlines. Its primary aim is to provide the best service possible and in the safest manner possible.

American Airlines employs over 17,000 people, of which only 10% are flight personnel. The remaining 90% take care of your reservations, baggage, preparation of meals, maintenance of planes, traffic control, weather analysis and so on.

As for safety, American Airlines has the best record in the industry, due mostly to their system of **"Preventative Maintenance."** Every 125 hr of flight time requires, on the average, 100 hr of maintenance time. The engines go through a complete overhaul at the end of every 1600 hr. At the end of 10,000 hr it can be safely said that there is not one original part left to the plane. As for the pilot, besides the rigid requirements to become a pilot, he must pass a physical exam three times a year and must pass a written exam twice a year.

At each major airfield in its system, American Airlines has its own meterologist who works in conjunction with the weather bureau. The weather not only determines whether or not a plane will fly but also the plane's speed, its height, route, and the flying time.

All of these factors have resulted in a prompt, courteous and dependable service that has made air travel larger than ever and made American Airlines the largest carrier in the world.

—submitted by E. C. Moynihan

New England

Field Editor
G. T. Brown
Jan. 4

THE CONTINENTAL DIVISION THAT IS GOING TO BUILD THE CONTINENTAL CAR IS BOTH THE YOUNGEST AND THE SMALLEST DIVISION OF THE FORD MOTOR CO.

Ben D. Mills was the speaker before 150 members and guests of the New England Section after cocktails and an excellent dinner sponsored by the Lincoln and Mercury Division of Ford Motor Co.

The question period disclosed that the "Contintal" car will be available in the fall of 1955. It will be one of the best riding cars in production and will incorporate the best in foreign and American features available. **All powered features** will be found in it, including **steering, brakes, windows** and **seats.** It will not be classified as a radically changed feature car, but rather a car comprising the best of present features and the closest of tolerances in all its mechanical units. It will be exceptionally high in horsepower, but will not be of the so-called "Hot Rod" variety. The sales cost has not as yet been determined.

Section Chairman Gustav Heiber presented a 35 year Membership Certificate to Frank E. Johnson of Lincoln, Mass. and 25 year Certificates to W. W. Dunnell, Jr., Division of Industrial Cooperation, Massachusetts Institute of Technology, and John C. McMurray, Mack Products Co.

Field Editor
G. T. Brown
Feb. 1

QUICKER LOADING, LARGER CAPACITY AND FASTER MOVING EARTH OFF-HIGHWAY EQUIPMENT has been necessitated by the demand for speed in road building today. These were the opening remarks of the speaker, Alan McClimon, at the

So. New England Jan. 25

IN THE SPOTLIGHT as members of SAE are (left to right) C. Harry Nystrom, Southern New England Section chairman; SAE Past-President A. T. Colwell; W. Paul Eddy, SAE vice-president for Engineering Materials; John G. Perrin, 50-Year member, Lawrence E. Crooks, 25-Year member, George E. Platzer, 25-Year member, and Norman W. Lyon, 35-Year member.

Western Michigan Jan. 18

From Section Cameras

STANDING IN FRONT OF THE CHEVROLET with the new V-8 engine is Russell F. Sanders, Chevrolet Motor Division, General Motors Corp., who spoke on the new engine at the meeting.

February meeting.

McClimon, manager of sales development for Euclid Road Machinery Division, General Motors Corp., made a comparison of public interest in regards to highway construction when he disclosed that in Britain general public interest demand for better roads is decidedly lacking. In the United States, public interest is keen. However, our gasoline tax systems and other present forms of fund provisions are inadequate and cause delays in an urgent need for more and better road construction.

The question period brought to light that, like all other progressive businesses, off-road equipment will change scientifically as demand for such changes are evidenced. These changes must be of an evolutionary nature with a compromise in design for various job conditions. Revolutionary changes are not usually successful, since the need for constant modifications create down time loss and exceptional added expense.

Mohawk-Hudson

Field Editor
J. B. James
Dec. 14

15 COMPANIES ARE ENGAGED IN AUTOMOTIVE TURBINE WORK. Five of these are in the United States. This was stated by Alvia A. Hafer, General Electric Co., during a panel discussion on "The Automotive Gas Turbine, What is Its Future?" Hafer pointed out advantages, such as smoothness and high power per weight, and disadvantages including high fuel consumption. He reviewed the specifications of many experimental models.

Albert R. Hillman, Fort Edward Express Co., presented the needs of the trucking industry. High horsepower would be of use, but economy cannot be sacrificed.

George W. Pusack, Socony-Vacuum Oil Co., Inc., outlined the fuel requirements and predicted that the **first production turbine automobiles will be luxury cars that can operate on gasoline.**

Dale H. Brown, General Electric Co., explained a few fundamentals of gas turbines, pointing out that small sizes are less efficient. This is largely due to higher effects of boundary layer flow.

St. Louis

Field Editor
Gene Kropf
Jan. 18

"LET'S MAKE STEEL," was the cry on the night of Jan. 18, when more than 150 members and guests of the St. Louis Section visited the Granite City Steel Co. at Granite City, Ill.

In one of the most interesting tours conducted by the Section in recent years, the membership was treated to a number of most interesting operations. Granite City Steel ranks 19th in the nation as the producer of fine quality steel, and in a plant recently modernized at a cost of $90,000,000, the members had an opportunity to see some of the most modern equipment in the world.

The tour was well conducted, taking a route through the **open hearth furnaces,** where up to 300 ton of molten metal was being made in each furnace. Then on to the **new blooming mill** that has been in operation for about one year. Here the workable ingots from the furnaces are rolled into semi-finished slabs. Next stop was the **hot strip plant** where steel slabs, hot from the reheating furnaces, pass through several mills operating in tandem. These roll out the slabs to long strips up to ¼ in. thick. The strips are then automatically coiled for ease of handling. The coils are then moved on to the **cutting department** for the completion of the order or on to a **cold roll plant** for further reduction.

Following the tour a lunch was served in the cafeteria of the plant and the members departed for home with the glare of the open furnaces in the background—a reminder of an evening well spent.

Field Editor
Gene Kropf
Jan. 28

THE ANNUAL THEATER PARTY was held by St. Louis Section on the night of Jan. 28. Gathering at 6:30 P.M. for a cocktail party, the group of more than 200 enjoyed a fine dinner served at the St. Louis Artists Guild Hall and then attended a well performed local-talent production of "Bell, Book and Candle." As in past years a number of attendance prizes were donated by local firms and the wives were treated to baby vanda orchids flown in from the Hawaiian Islands by United Air Lines for the occasion.

A number of local company members serve as sponsors for the annual affair. This year the sponsors included: Wagner Electric Co., Sunnen Products Co., Sterling Aluminum Co., H. and H. Machine & Motor Parts Co. and United Air Lines.

Canadian

Field Editor
F. G. King
Jan. 21

ONE OUT OF EVERY EIGHT employees in Canada's aircraft industry could be classed as an engineer. That is what Air Marshall W. A. Curtis, vice-chairman of the board, A. V. Roe Ltd., told members at "Aviation Night."

The aviation industry is an "Engineer's" industry, and can be regarded as an extremely interesting and challenging career for any young Canadian looking to engineering as his life's work.

Many new problems confront the industry in the development of high altitude flying at supersonic speeds, such as the **Thermal Barrier,** a natural phenomenon arising from air friction against the fast moving aircraft's surface. Heat difficulties of the past faced by airframe and engine designers will seem insignificant in the light of future prob-

From Section Cameras

Canadian Jan. 21

"AVIATION IS AN 'ENGINEER'S' INDUSTRY," said Air Marshall W. A. Curtis, vice-chairman of the board, A. V. Roe, Ltd., at Canadian Section's "Aviation Night."

Central Illinois Jan. 24

IN CONFERENCE are (left to right) Section Chairman Randall Roman, Speaker Rudolph Birmann, De Laval Steam Turbine Co., and Technical Chairman Lloyd E. Johnson.

San Diego Jan. 11

IN CLOSE QUARTERS AT DINNER are San Diego members of SAE, ASTE and ASME, numbering approximately 500. A joint meeting was held featuring the Pan-American Road Race.

lems.

The aeroplane has contributed more to Canada's development in the last 25 years than any other item. The very vastness of the country makes aviation a vital necessity for both defense and peacetime development.

Southern California

Field Editor
W. E. Achor
Dec. 13

THE RAILROADS GO PIGGY BACK. This form of transportation where highway trailers are loaded on railroad flat cars, dates back to the middle of the 19th century when sections of canal boats were loaded on flat cars. The first regular service began between Chicago and St. Paul and then on the New Haven Railroad between New York and Boston in 1937. From that time on, this method of transportation has taken hold in various sections of the country.

Harold Hemphill, assistant general freight agent of the Atchison, Topeka & Santa Fe Railway, provided this information in his talk called "Piggy Back Crystal Ball".

Service is presently confined to railroad owned trailers, but in the not too distant future, it is probable that the trailers of common carriers will be handled. Commodity rate list is now limited but will gradually be extended to cover almost all items handled by truck and rail. "Piggy Back" provides a co-ordinated service which **tends to take trucks off the over crowded highways in inter-city transportation,** is **damage free** and **pilfer proof.** Rates are comparable to current truck rates.

William R. Daly, secretary of the Maritime Committee of the Los Angeles Chamber of Commerce, commented briefly on the great future of "Piggy Back" to water transportation. Up to 40% of the cost of water transportation is in handling charges. Application of new loading and handling techniques have lagged and service has been badly hampered by maritime strikes. As a result, **new types of ships** are being considered for coast wise freight service. These ships would **carry up to 240 loaded trailers** and would travel at about **20 knots per hour.** Such ships could be **unloaded in 4 hr** as against 2½ days for conventional freighters. These trailer ships would not require stevedore service. For obvious reasons the Defense Department is watching the development of such ships with great interest.

Assistant Field Editor
R. S. Orchard
Jan. 10

BUILDING A FIRE IN A FIRE PLACE is successful only when proper preparations are made. The same preparations are equally necessary to obtain efficient combustions in a two-cycle diesel engine. John May, in charge of Combustion and Injection Development for the Detroit Diesel Division, General Motors Corp., explained that knowledge of combustions is still very limited.

In explaining the development and progress of the General Motors Model 71 Diesel, May said that since 20% of available hp is used to operate the blower, the **efficiency of the air system is as important a problem as that of the fuel injection system.**

From 1939 to 1954, hp output of the Model 71 engine has been increased from 160 to 240 with about the same fuel consumption. The many improvements in design have also resulted in great reductions in maintenance cost. On some inter-city bus lines the fixed period for overhaul is 300,000 mi.

Until diesel engines are greatly reduced in weight and cost, they will not offer a serious threat to gas engines for passenger car use. However, gas turbines constitute a serious threat to the diesel engine. The future indicates great possibility for turbocharging, May believes.

Colorado

Field Editor
P. G. Anderson
Dec. 16

SUPERCHARGING WILL INCREASE ENGINE HP BY AS MUCH AS 40% according to John W. Oehrli, consulting engineer, McCulloch Motors Corp., in presenting his paper "Development of the McCulloch Supercharger for Automotive Diesel and Gasoline Engines." The amount of increase in hp due to supercharging will vary with the basic design and also the altitude at which it is operated. Oehrli concluded that, in general, **the best way to achieve increased hp in a given engine is to supercharge it.**

In the discussion period following the paper, two of the group who have personal experience with the McCulloch Supercharger stated that **drivers** of cars equipped with it **must change their driving habits due to the very marked increase in acceleration.**

Cincinnati

Field Editor
Owen Negangard
Jan. 25

THE WORLD'S MOST GRUELING RACE OF MEN AND MACHINES was the opinion of the attending members and guests of the Cincinnati Section after a descriptive presentation of the Mexican Road Race by Joseph R. Gillette of the Lincoln-Mercury Division of Ford Motor Co.

Gillette's presentation was accompanied by colored slides, which further convinced the audience of the competition in this unusual race. Since the 1954 films were not available for showing, Gillette brought along the 1953 films, which commanded the attention of all present. The 1954 films were promised to the Section by Gillette for showing as soon as they were available, and they should prove a drawing card for another well attended meeting.

Syracuse

Field Editor
L. L. McArthur
Dec. 9

BUILDING A PLANT, DESIGNING A PATTON SE-

PARTICIPANTS in the Panel meeting sponsored by the Junior Group are (seated left to right) Paul M. Clayton, Ford Motor Co.; William E. Drinkard, Chrysler Corp.; Harry F. Barr, General Motors Corp.; Robert O. Williams, Packard Proving Grounds; Robert F. Carlson, Ford Motor Co.; Richard G. Abowd, Ethyl Corp.; and standing, Charles R. Barbour, Ford Motor Co.

Detroit Jan. 24

South Bay Division

PLANNING EVENTS FOR THE WINTER AND SPRING at the governing board meeting are members of the board (left to right, standing) C. F. Carey, SAE Journal field editor; F. W. Fingerle, membership chairman; W. A. Casler, publicity; F. L. Jarrett, program chairman; G. R. Picolet, placement chairman; J. V. Harris, treasurer; and (seated left to right) V. C. Gilbert, secretary; H. G. Leonard, student chairman; W. J. Adams, Jr., chairman; and R. A. Hundley, reception chairman.

RIES TANK, AND PRODUCING THE FIRST TANK IN ELEVEN MONTHS was the problem confronting speaker J. F. Kerigan, president of New Process Gear Corp., Syracuse, N. Y.

This all started in 1950 with a large lot in Newark, Del. and orders to "get going." Kerigan explained the problems of converting chicken farmers to machine operators, procuring machinery and getting production rolling when sometimes the roof wasn't quite over the machinery.

A movie showed the superiority and maneuverability of the M-48 and T-43 over the tanks used in World War II. The many advantages of this tank depend to some extent on the **simplified hydraulic system.** The extent of this simplification would be a debatable issue.

Atlanta

Field Editor
D. J. Tolan
Jan. 3

GROWING PAINS OF THE AUTOMOTIVE AND LUBRICATION INDUSTRIES were described by C. M. Larson of the Sinclair Refining Co. Larson, a member of SAE since 1920, presented the 50 year history of SAE together with a corresponding history of lubricants development. 75 members and guests heard Larson recount personal anecdotes that described those growing pains.

Field Editor
D. J. Tolan
Jan. 28

ANNOUNCEMENT OF ADVANCE TO SECTION STATUS was made to Atlanta Group by Hollister Moore during this SAE 50th Anniversary meeting. Moore stated that the Atlanta Group had qualified for Section status by leading the country in percentage growth this past year. He encouraged the Section to continue the program of active recruitment with emphasis on quality of applicants.

A record turnout of 110 members and guests joined SAE President C. G. A. Rosen in celebrating the SAE 50th Anniversary and advance to Section status for the Group. Rosen spoke on the effects of Alexander Botts, the Earthworm Tractor salesman, on engineering design. He pointed out that imaginative examination of current problems indicates the possible solutions. Rosen pointed out that several devices and methods used by Botts in the field have since been incorporated in the design and operation of commercial equipment.

Northern California

Field Editor
R. E. Van Sickle
Dec. 15

27 AIRLINES HAVE ORDERED THE TURBO-COMPOUND ENGINE

Facilities for repairing and overhauling jet and piston engines at the U. S. Naval Air Station at Alameda were inspected by Section members. The operations performed at this plant are impressive, and the scheduling techniques that enable hundreds of parts to progress through the shops on their individual routes, eventually being reassembled in the same engines from which they were removed, are amazing. Following the tour, members enjoyed dinner at the Officer's Club and listened to talks on military flight experiences by Cmdr. R. H. Vorhis and Cmdr. A. H. Clancy, Jr.

At the technical session, Kenneth J. Boedecker, Wright Aeronautical Division, Curtis-Wright Corp., spoke on "The Wright Turbo-Compound Engine and Its Airline Operating Problems." In describing the engine and its development, Boedecker pointed out that **6,000 turbo-compounded engines have accumulated more than 2,000,000 hr.**

Causes and cures for operational problems that cause premature engine removals were discussed. Most frequent problems have occurred with impeller drive gear train, pistons and rings, and valve springs. Differences in the manner in which turbo-compounded and conventional engines are operated were also explained.

Field Editor
C. F. Carey
Feb. 1

MAGNETISM ADDS SPEED TO TESTING.

Experimental stress analysis and non-destructive methods of testing were the twin topics presented at this South Bay Division meeting. Robert G. Strother and Richard D. Turner, western district manager and field engineer, respectively, for Magnaflux Corp., presented the double-header.

The use of brittle coatings—lacquers and ceramics —was discussed. Strother stated that the **newly developed ceramic coatings will find applications at higher temperatures** where lacquers are unsatisfactory.

The speed with which parts can be inspected for flaws by magnetic means was discussed by Turner. He provided examples of defective parts of the sort detected magnetically and showed slides of several types of testing equipment in use today.

A film on the Pan-American Road Race followed the double-header.

Western Michigan

Field Editor
W. C. Chaffee
Jan. 18

AN OVERFLOW CROWD OF 250 ENGINEERS FROM WESTERN MICHIGAN heard Russell F. Sanders of Chevrolet Motor Division talk on the development of the new Chevrolet V-8 engine at Bill Stern's Steak House in Muskegon. Sanders stated that in designing the new V-8 engine with 265 cu in. displacement, **the prime objective was to make it as small as possible.** The cylinder block was designed for high precision in the casting process and the cylinder barrel cores are formed in pairs. In designing the cylinder head and other cast elements, careful attention was paid to obtain castings of a precision nature with low weight and good rigidity in mind.

Many novel features of the design of the engine

From Section Cameras

Chicago—South Bend Division Jan. 31

CONGRATULATING Leo A. Bixby, right, Bixby Management & Engineering Counsel, on his 35 years with SAE, is M. P. de Blumenthal, chairman of Chicago Section.

New England Jan. 4

APPEARING TOGETHER at the Jan. 4 meeting are (left to right) Chairman Gustav Heiber; Joseph Fabely, Boston district manager of Lincoln-Mercury Division, Ford Motor Co.; and Ben D. Mills, assistant general manager, Continental Division, Ford Motor Co., the speaker.

Williamsport Jan. 2

SEATED AT THE SPEAKERS' TABLE are (left to right) B. S. Kratzer, Group secretary; Paul Cervinsky, Group program chairman; Thomas Conway, works manager, Avco Mfg. Corp.; W. T. Piper, Sr., president, Piper Aircraft Corp.; William Ribando, Group chairman; Joseph Gehret, ASTE chairman; Ewing Mueseler, automotive engineer at Williamsport Technical Institute; and Allan Weiss, Civil Aeronautics Administration representative.

were described in complete detail with illustrative slides showing how the exhaust manifolds near the top of the cylinder head simplify coring and brought the manifolds up out of the way of the steering mechanism. Such detail as this, and the use of a pressed forged steel crank shaft, made it possible to produce what Chevrolet engineers believe to be the smallest and lightest commercial V-8 power package for its displacement.

Visitors at the meeting had an opportunity to examine details of the motor installed in a new Chevrolet automobile.

Williamsport

Field Editor
B. L. Sharon
Jan. 2

NO ONE CAN KEEP UP with flying because it is changing so rapidly. This statement was made by W. T. Piper, Sr., president of Piper Aircraft Corp. of Lock Haven, Pa. A personal chronology of the development of his corporation and the aircraft industry was given after a dinner attended by 100 members and guests of the Williamsport group.

Piper related how his plant became located in Lock Haven after a fire destroyed the original plant in Bradford. From the very earliest designs of modern light aircraft, engineers were **striving for horsepower with maneuverability.** "People wanted horsepower—we built gliders and they didn't sell," he recalled.

Beginning with a small two cylinder engine, Piper engineers experimented with many engines before adopting a 90 hp engine in pre-depression days. Up to this time, the Piper was called the "Kitten," but because it was so playful and yet untamed, the trade name soon changed to "Cub."

A series of developments in the light plane industry kept increasing the hp of the Piper product from 90 to 105, 115, 125, and finally to the present 150.

"As I see it," Piper said, "all planes in the future will be **tricycle landing gear** craft." He explained the ease of handling, the non-slip and non-skid qualities of the tricycle landing gear.

San Diego

Field Editor
M. E. Morrison, Jr.
Feb. 3

SEATED BEHIND THE WHEEL were members and guests of San Diego Section on Jan. 11. A social-hour, a dinner, and a film of the Mexican Road Race were the highlights of this joint meeting with the American Society of Tool Engineers and the American Society of Mechanical Engineers.

Ray Crawford, winner of the last race, was present to narrate his films of the entire race. These colored films were taken by means of gun cameras mounted inside the winning Lincoln and supplemented by scenes taken by the follow-up truck and an airplane. An auxiliary speedometer was rigged up in view of the camera so that the audience could note the car speed under all maneuvers. This type of arrangement gave the viewers an extremely realistic picture by literally placing them in the driver's seat.

One might think that the co-driver, Enrique Iglesias, was mainly along for the ride, but Ray would certainly disagree with this. Enrique served as navigator, cameraman, timer, mechanic, and translator. At one time he even used his hand as a throttle spring.

All the cars in the race must be stock cars, and Ray stated that it cost him $3800 to get a perfect stock car. They were allowed to use larger (59 gal) gas tanks, however. The only fuel allowed was Super Mexalena and it appeared to be low in octane rating since severe detonation put several of the cars out of the race the first day.

Dayton

Field Editor
C. P. Kelley
Jan. 19

A 20-YEAR SUPPLY OF PETROLEUM is presently assured on the North American continent including Canada, according to Harvey W. Hanners, chief research engineer for the Engine Division of National Supply Co.

Retail prices of petroleum products will not increase at as rapid a rate as other merchandise during the next decade.

It costs from **$20,000 to $2,500,000 to drill an oil well,** estimated Hanners. If all of the oil wells drilled in a year were laid end to end they would stretch 30,000 miles, or total 160,000,000 ft, about four times through the earth.

A 35-Year Membership Certificate was presented to Harold Jackson, head of the Department of Automotive Engineering at Ohio Northern University, and a 25-Year Membership Certificate was given to H. M. Havens, vice-president in charge of engineering of Seagrave Corp., Columbus, Ohio.

Baltimore

Field Editor
H. T. Cline
Jan. 13

CONTROVERSIAL DISCUSSION WHERE THE FRICTION GENERATED MORE LIGHT THAN HEAT was heard by Baltimore Section at this meeting, according to Chairman W. H. Wilson.

Two speakers, Harry A. Witte of the Baltimore and Ohio Railroad and C. McBride of the American Truckers Association, discussed the "Piggy Back" or trailer on flat car method of shipping.

According to Witte, The Baltimore and Ohio has successfully operated and is expanding this service to provide the shipper with an all-weather freight service at a competitive freight rate. In the B & O system, the trailers are of limited size to enable two trailers to be loaded on a single flat car and also to conform to right of way clearances. He said that no damage had been experienced to trailers from shifting loads. Normal trailer loading procedures were found to be adequate since the service was given the special treatment of diesel powered thru trains.

McBride on the other hand, assured his listeners

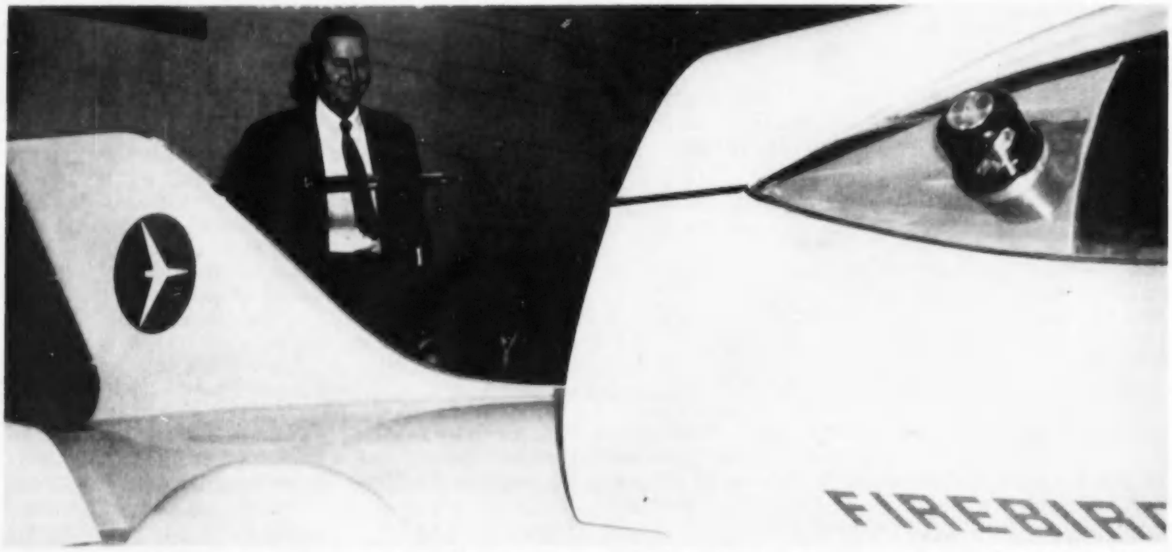
Northwest Jan. 21

APPLAUDING SPEECH by William Churchill, Northwest Greyhound Lines, Inc. and master of ceremonies, is Section Chairman C. E. Johnston, Edison Technical School.

Pittsburgh Jan. 25

PRESENTING a 25-Year Membership Certificate to Ross E. Willis (left), Mesta Machine Co., is Section Chairman H. Kenneth Siefers, United Oil Co.

Mid-Michigan Jan. 24



EXHIBITING the gas turbine-powered experimental Firebird at the Jan. 24 meeting of Mid-Michigan Section is W. A. Turunen, head of Gas Turbines Department, General Motors Research Laboratories.

that rubber tires were here to stay. Speaking for the ATA, he supported the "Piggy Back" method used by certain other railroads, where the trailers were the property of the truckers and shipment was a joint action between the railroad and the trucker. This method permits the truck dispatcher to select the best shipping route and direct the loaded trailer over highway or rail as required, thus providing a better, more flexible service. Certain railroads are developing tie down equipment with which any trailer may be loaded on a standard flatcar without modification to either.

It was stressed that despite any future expansion of the "Piggy Back" method, the existing requirement for highway development and improvement will not be lessened.

Pittsburgh

Field Editor
D. W. Gow
Jan. 25

OVER-ALL OPERATIONAL SAVINGS OF MORE THAN $125,000 A YEAR by the police department of a large city are attributed to the use of automatic transmissions, stated A. J. Pepper of the Ford Motor Co. A reduction of approximately 50% in transmission maintenance costs for the present automatic transmission vehicles over the former cars equipped with standard transmissions accounts principally for these savings.

In discussing the application of automatic transmissions to commercial vehicles, Pepper described the typical characteristics of their design and control, outlined their basic advantages of reduced maintenance cost and increased driver efficiency, described their use in light truck and passenger car service, and related the success that they have achieved in these applications. In the heavy duty field, automatic transmissions have proven themselves in the bus industry and appear promising in tests presently being conducted in heavy duty trucks.

Northwest

Field Editor
S. J. McTaggart
Jan. 21

OLD TIMERS' NIGHT was the theme of the Golden Jubilee meeting symbolizing the progress of the automotive industry and SAE through the last half century. W. W. Churchill, assistant general manager of Northwest Greyhound Lines, Inc., was a gracious and competent master of ceremonies. **All past chairmen** residing in the area were in attendance to help make this the meeting of the year.

Direct reports of the SAE Golden Anniversary Annual Meeting were presented by Northwest representatives John Holmstrom, Kenworth Motor Truck Corp.; Robert Norrie, Kenworth Motor Truck Corp.; and Otto Kirchner, Boeing Airplane Co.

The evening's entertainment was concluded by "Strange Interview," the popular movie on human relations.

Student Branch activities are at an all time high and their interest in Section meetings has been lauded by many of the prominent members.

—Submitted by C. Drozynski

Hawaii

Field Editor
F. L. Helbush
Jan. 17

FATHER & SON MEETING IN HAWAII.

Hawaii Section members and sons gathered at the District Office of the Civil Aeronautics Administration Building for the first meeting of the year.

Culver Rausch, educational director of CAA and four members of his staff put on an interesting skit simulating a flight. Members and guests were then taken to the control tower of the Honolulu International Airport where they watched the tower control men land and take-off several large planes. Some of the members had the opportunity of watching an operator bring in a plane by radar.

The tour through the message receiving and sending center, which came next on the agenda, turned out to be like a three-ring circus.

Edgar N. Smith, regional administrator of CAA, was the main speaker at dinner.

Southern New England

Field Editor
A. D. Nichols
Jan. 25

THE PAST 50 YEARS HAS SEEN MUCH OF THE BURDEN REMOVED FROM THE BACKS OF MEN; the next 50 years will see much of the burden removed from the minds of men with the prefection of electronic computers, calculators, and integrators, said A. T. Colwell, speaking on "This Fantastic Engineering Era".

Colwell, vice-president of Thompson Products, Inc. and a past-president of SAE, stated that the greatest revolution or evolution the world has ever known has taken place chiefly in the past 50 years. This period has seen the growth of all forms of transportation. Methods of defense have changed completely with the advent of atomic warfare. We have already seen an atomic power plant operate satisfactorily in the submarine Nautilus.

Just before Colwell's talk, W. Paul Eddy, Pratt & Whitney Aircraft Division, United Aircraft Corp. and SAE vice-president, Engineering Materials, spoke briefly on the growth of SAE over the past 50 years. Eddy presented 25-year Membership Certificates to Lawrence E. Crooks, Hamden, Conn.; George E. Platzer, J. C. Tarbell Associates, Inc.; and Igor I. Sikorsky, Sikorsky Aircraft Division, United Aircraft Corp. He presented a 35-Year Membership Certificate to Norman W. Lyon, Package Machinery Co. and gave a gift to 50-year member John Perrin, Springfield, Mass. Perrin, one of the original founders of SAE, also spoke briefly on the business and transactions of some of the first SAE meetings 50 years ago.

Detroit

Field Editor
G. F. Gass, Jr.
Jan. 24

THE USE OF THE "SYNCHROPINGER" in the analysis of engine deposit rates occurring at various points in the 4 stroke cycle was explained by Richard G. Abowd, project engineer, Ethyl Corp., during the Detroit Junior Group panel discussion of engine testing. Three Junior members covered the progressive development of the internal combustion engine from the single cylinder research stage through the dynamometer development phase to the final road test acceptance.

Abowd explained that the synchropinger is a disc with 32 pins around the circumference. The disc rotates at half crankcase speed. Through a 1/32-in. hole drilled in the combustion chamber, gases escape and impinge on the pins, building up deposits typical of particular fractions of the combustion cycle. Ethyl uses the device to study potential lead scavengers.

Robert F. Carlson, project engineer of Ford Motor Co., enumerated the reasons for the necessity of dynamometer testing. His paper also discussed the development stages of a relatively new spark plug.

Robert O. Williams, experimental engineer, Packard Proving Grounds, demonstrated the requirements for road testing as an assurance of an acceptable product.

During the question and answer period, three Senior member experts added their comments and observations to the panel's answers. The Senior members were Paul M. Clayton, chief engine engineer, Ford Motor Co.; William E. Drinkard, assistant chief engineer in charge of engine development, Chrysler Corp.; and Harry F. Barr, assistant chief engineer, Chevrolet Motor Division, General Motors Corp.

Chicago

Field Editor
D. W. Miller
Jan. 31

RELIABILITY OF THE DART ENGINE was stressed by C. M. Rice, project engineer, Aviation Gas Turbine Division of Westinghouse Electric Corp., who presented a paper on "The Dart Propeller—Turbine Engine" to approximately 150 members and guests.

The **Dart engine** is a **turbo-prop engine in which the propeller and the two centrifugal compressor rotors are driven by a two-stage turbine.** The compressor is directly coupled to the turbine and the propeller is driven from the front end of the compressor through a compound reduction gear train.

Rice discussed the early history, development, and application of the Dart engine to commercial airlines in England, stating that the same engine will be in use in this country some time in the summer of 1955.

A 35-Year Membership Certificate was presented to Leo A. Bixby, Bixby Management and Engineering Counsel, and 25-Year Certificates were presented to John A. Binder, Studebaker-Packard Corp.; Isaac Char, Clark Equipment Co.; T. A. Scherger, Studebaker-Packard Corp.; and C. V. Johnson, Bendix Aviation Corp.

Mid-Continent

Field Editor
L. D. Reis
Jan. 21

INTERESTING INFORMATION concerning maintenance of automotive equipment was provided during the panel discussion on **transportation and maintenance.**

R. E. Linnard, vice-chairman, was moderator of the program and the panel was made up of W. H. Esser, manager of the Transportation Department of Shell Oil Co., Tulsa; Wade Johnson, automotive engineer, Continental Oil Co., Ponca City; Fay Cook, manager of engine maintenance, Service Pipe Line Co., Tulsa; Frank J. Koch, manager of automotive maintenance, Southwestern Bell Telephone Co., Oklahoma City; and Roland Cox, automotive engineer, Halliburton Oil Well Cementing Co., Duncan.

Wichita

Field Editor
G. W. Jones
Jan. 19

THE OIL PRODUCING COMPANIES OF SAUDI ARABIA have a big problem in transportation. This was voiced by Richard Kerr of the Arabian-American Oil Co. in a paper presented to the Wichita Section.

The oil producing area of Saudi Arabia has physical characteristics very much like New Mexico, Arizona, and Utah. Transportation in this arid region must be by camel, air, or cars and trucks. The cars and trucks must have exceptionally **large low pressure tires.** The **cooling systems** of the cars and trucks **must be larger** than that used in the United States due to the high summer temperatures. All of the vehicles are **radio equipped.** Lubrication and filtering are also a constant problem in keeping sand out of engine parts and other working parts.

Mid-Michigan

Field Editor
R. D. Jacobs, II
Jan. 24

EXHIBITION OF TWO EXPERIMENTAL GAS TURBINE POWERED VEHICLES was held at the meeting at the General Motors Institute on Jan. 24.

Description of the installations and the history of the experimental work carried out with them was provided by W. A. Turunen, head of the Gas Turbines Department, General Motors Research Laboratories. Turunen presented similar material at the 1954 Summer meeting, and those not able to study these developments at that time were happy to hear him in Mid-Michigan.

TECHNICAL COMMITTEE *Progress*

SAE Helps Develop Standards For Bearing and Spline Retainers

THE Bureau of Aeronautics and the Air Force, with the cooperative effort of SAE Engine and Propeller Standard Utility Parts Committee E-25, have prepared standards for light-weight spanner nuts and tab washers for the retention of anti-friction bearings and splined components on shafts.

Considerable variation now exists in present commercial standards and similar aircraft company parts with respect to the number of locking tangs, number of slots in the nut, and the overall washer and nut configurations. Release of these standards now provides industry a retention of realistic proportions in regard to weight and space requirement. This reduction of weight and savings of space is vital in the field of aeronautical design.

These standards have recently been issued by the Aeronautical Standards Group, for the Department of Defense, under the following title and number identifications:

(a) Washer-Key, Bearing Retaining, Aeronautical MS172201 thru MS172235
(b) Nut-Spanner, Bearing Retaining, Aeronautical MS172236 thru MS172270
(c) Washer-Key, Aeronautical MS172271 thru MS172320
(d) Nut-Spanner, Aeronautical MS172321 thru MS172370

The washers and spanner nuts, noted as (a) and (b), were developed primarily for the retention of bearings having shaft bearing bore diameters ranging from 0.3937 through 4.3307. The washer standards as issued currently call for AMS 6357 steel. But revisions now under way call for AMS 6350 steel.

The nuts are made from AMS 6322 steel and are hardened to Rockwell C26 to 32. There are eight slots in the nut which reduces the angular travel index for locking with the tabs of the washer to one-half of that required by the SAE commercial standard for ball bearing retention. Phosphate treatment, in accordance with AMS 2481, is specified for both the washer and nut to provide a corrosion protection suitable for internal parts that are in contact with engine oil.

Cadmium plating of such parts has proven objectionable in that the shearing off of the plating tends to foul the lubricating system and also forms cadmium soaps. The phosphate treatment provides nominal corrosion protection for parts used in outside applications.

The design of these combinations was predicated on the primary basis of a minimum of three full threads in shear, adjusted to provide an adequate bearing area for wrench torque.

The resultant weight reduction as compared to the existing commercial standards varies from 38% for the 0.3937 bore diameter to 72% for the 4.3307 bore diameter, or an average of 55% over the range of listed sizes. They are interchangeable as a combination with the SAE commercial standards.

The washers and spanner nuts noted as (c) and (d) have been developed primarily for the retention of components on shafts where the propelling torque is applied by means of splines, flats, or keys. The shaft thread and spline combination accommodated by these parts ranges from a 0.500-28NEF3 thread and 20/40 diametral pitch 13-tooth spline, advancing by 1/16 increments of shaft thread size, through a 2.500-16N3 thread and 16/32 diametral pitch 43-tooth spline. Spline sizes are as listed in SAE Aeronautical Standard 84. The materials and protective treatment of these parts are the same as for the washers and nuts for bearing retentions.

These standards are the first military standards to be developed for tab washers and spanner nuts. They represent a considerable amount of research and project engineering time by the members of SAE Committee E-25 and the project sponsor W. B. Billingham, of Hamilton Standard Division of United Aircraft Corp.

The washers for bearing retention,

W. B. Billingham

Sponsor of project on aircraft spanner nuts and tab washers, SAE Committee E-25

noted as (b), provide a single shaft key similar to the existing commercial types. A washer having two shaft keys to withstand greater wrench torque at installation and provide a higher safety factor, is now under development by SAE Committee E-25. This standard will be identified as MS9081 and will cover the same range of bearing bore diameters as the published standard.

Recently Approved By The Technical Board . . .

Reserve Tractive Ability: A recommended procedure for determining the reserve tractive ability of all types of self-propelled construction and industrial vehicles (with mounted and/or trailed equipment, with or without pay load) has been approved. It's the first of a series undertaken at the request of the Corps of Engineers, U. S. Army, and members of the staff of the Engineers' Research and Development Laboratory, Fort Belvoir, Virginia. The object of a reserve tractive ability test is to determine the ability of a self-propelled vehicle to develop tractive force and power beyond that required to move itself. Reserve Tractive Force is represented in pounds and Reserve Tractive Power in horsepower.

Vehicle Drag: A test code for determining vehicle drag of construction and industrial vehicles has also been developed. A vehicle drag test determines the external force required to maintain travel speed on a specified course. Vehicle Drag Force is represented in pounds. The test may also be used to determine the resistance to motion of a self-propelled vehicle.

Surface Roughness: The American Standard for measuring surface roughness is now based on arithmetic average instead of root mean square average. Roughness measuring instruments calibrated for rms will be found to read approx. 11% higher than those calibrated for aa. In many cases they can be adjusted to read arithmetic average.

Precision Reference Specimens may be used in calibrating instruments. The normal surface profiles of the Specimens consist of a series of isosceles triangles having included angles of 150 deg.

In an appendix to the Standard, five roughness width cutoff lengths have been designated: .003, .010, .030, .300, 1.000 in. The preferred length is .030 in.

Iron and Steel "Old Timers" Meet

JUST for old times' sake, this group of men who were active in past years in the work of the SAE Iron and Steel Technical Committee joined the ISTC Executive Committee for a dinner during the Golden Anniversary Meeting.

Seated are (left to right): R. B. Schenck, F. P. Gilligan, and W. Paul Eddy, Jr. Standing are Roy W. Roush, Glen Riegel, J. L. McCloud, F. C. Young, Harry Knowlton, L. A. Danse, and Hy Bornstein.

Some of the men have retired. Others are no longer active members of ISTC. But all continue their interest in their long-time ISTC associations.

CRC Releases Five New Reports

THE following Coordinating Research Council reports have been released for distribution and are available from SAE Special Publications Department, 29 West 39th Street, New York 18, New York.

(This is a complete list of CRC reports released since publication of the listing of CRC reports on page 88 of the March, 1954 SAE Journal.)

Motor Fuels

Combustion

CRC-277—Four Proposed Methods of Measuring End-Gas Properties (1/53) Priced $5.00 to SAE members; $10.00 to nonmembers.

CRC-278—Terms for Use in Otto Cycle Engine Combustion (6/54) Priced: 35¢ to SAE members; 60¢ to nonmembers.

Detonation—Full Scale

CRC-280—Octane Number Requirements Survey, 1953 (2/54) Priced: $4.00 to SAE members; $8.00 to nonmembers.

Aviation and Motor Fuels

Detonation—Laboratory

CRC-281—Investigation of Combustion Phenomena by Means of High-Speed Photography, (5/54) Priced: 50¢ to SAE members; $1.00 to nonmembers.

Diesel Fuels

CRC-279—Combustion Characteristics —Ignition Delay Bomb, 1951-1952 (12/53) Priced: $1.50 to SAE members; $3.00 to nonmembers.

ISTC Organizes Gear Steels Division

THE SAE Iron and Steel Technical Committee has set up a new division, Division XXXIII—Gear Steels to study carburized boron steels and other types of gear steels.

Harold J. Bates of Fairfield Manufacturing is chairman of Division XXXIII. He hopes that the Division will be able to begin a cooperative test program on carburized boron steels.

CRC Chief in '55

E. S. MacPHERSON has been elected president of the Coordinating Research Council at its Annual Meeting. He succeeds **W. J. Sweeney. W. M. Holaday** succeeds MacPherson as vice-president.

Three men nominated by API and three nominated by SAE were re-elected to two-year terms as directors. Those named by API are **C. E. Davis, H. W. Field, and W. J. Sweeney.** The SAE-named directors are **L. L. Bower, W. G. Lundquist,** and MacPherson.

Lacey Walker was re-elected CRC treasurer. **T. B. Rendel** and **W. T. Gunn** were appointed assistant treasurers.

Aero Materials Specs Reviewed by Industry

DRAFTS of thirty-nine SAE Aeronautical Materials Specifications are currently being circulated to industry for comment and criticism by the SAE Aeronautical Materials Specifications Division.

Fourteen specifications have been approved recently by the SAE Technical Board.

Copies of all of these specifications are available for review from the SAE Aeronautical Department, 29 West 39 Street, New York 18, N. Y.

The specifications under review are:

- AMS 2400K—Cadmium Plating;
- AMS 2416—Nickel-Cadmium Plating, Diffused;
- AMS 2670C—Copper Furnace Brazing, Carbon and Low Alloy Steels;
- AMS 4090—Aluminum Alloy Tubing, 1Mg-0.6Si-0.25Cu 0.09Cr (62S-H11);
- AMS 4135H—Aluminum Alloy Forgings, 4.5Cu-0.9Si-0.8Mn-0.5Mg (2014-T6);
- AMS 4139F—Aluminum Alloy Forgings 5.6Zn-2.5Mg-1.6Cu-0.25Cr (7075-T6);
- AMS 4777—Brazing Alloy, Nickel Base —4Si-7Cr-3Fe-3B;
- AMS 4778—Brazing Alloy, Nickel Base —4Si-2.6B;
- AMS 4890—Copper-Beryllium Alloy Castings, Precision Investment 2Be-0.4Co-0.3Si;
- AMS 4900A—Titanium Sheet and Strip, Annealed—55,000 psi Yield;
- AMS 4901B—Titanium Sheet and Strip, Annealed—70,000 psi Yield;
- AMS 5380B—Alloy Castings, Precision Investment, Corrosion and Heat Resistant, Cobalt Base-26Cr-15Ni-6Mo;
- AMS 5390—Alloy Castings, Precision Investment, Corrosion and Heat Resistant, Nickel Base-22Cr-1.5Co-9Mo-0.6W-18.5Fe;
- AMS 5393—Alloy Iron Castings, Sand, Corrosion and Heat Resistant 2Cr-20Ni;
- AMS 5524B—Steel Sheet and Strip, Corrosion and Heat Resistant 18Cr-13Ni-2.5Mo (SAE 30316);
- AMS 5546—Magnetic Alloy Sheet and Strip, Nickel Base 1.35Cr-4.5Cu-17Fe;
- AMS 5566C—Steel Tubing, Corrosion Resistant, 19Cr-10Ni (SAE 30304), High Pressure Hydraulic;
- AMS 5573A—Tubing, Seamless, Corrosion and Heat Resistant 17.5Cr-12.5Ni-2.3Mo (SAE 30316);
- AMS 5591C—Steel Tubing, Seamless, Corrosion Resistant 12.5Cr (SAE 51410);
- AMS 5625—Steel, High Expansion, 5.5Mn-9.5Ni (0.55-0.65C);
- AMS 5642C—Steel, Corrosion and Heat Resistant, 18Cr-11Ni-(Cb+Ta) Free Machining;
- AMS 5663—Magnetic Alloy, Nickel Base-1.35Cr-4.5Cu 17Fe;
- AMS 5684B—Welding Electrodes, Coated, Alloy, Corrosion and Heat Resistant, Nickel Base-15Cr-9Fe-2(Cb+Ta);
- AMS 5687B—Alloy Wire, Corrosion and Heat Resistant, Nickel Base-15.5Cr-8Fe, Annealed;
- AMS 7207A—Spring Pins, Corrosion Resistant Steel;
- AMS 7232C—Rivets, Alloy, Corrosion and Heat Resistant, Nickel Base-15.5Cr-8Fe;
- AMS 7292—Labels, Aluminum Foil (Anodized);
- AMS —— Steel Castings, Sand, Corrosion Resistant 17Cr-4Ni-4Cu;
- AMS —— Bolts and Screws, Corrosion and Heat Resistant Roll Threaded;
- AMS —— Steel Castings, Precision Investment, Corrosion Resistant, 16Cr-2.3Ni.
- AMS —— Labels, Aluminum Foil (Enameled);
- AMS —— Coating Alloy, Nickel Base —4.5Si-15Cr-4.5Fe 3.5B-0.8C;
- AMS —— Steel Tubing, Welded, Corrosion and Heat Resistant 18Cr-11Ni-Cb+Ta, (SAE 30347) (Thin Walled);
- AMS —— Steel Tubing, Welded, Corrosion and Heat Resistant 18Cr- 10Ni-Ti (SAE 30321) (Thin Walled);
- AMS —— Magnesium Alloy Castings, Sand, 3.5Ce-1Zr;
- AMS —— Magnesium Alloy Castings, Sand, 3.5Ce-1Zr;
- AMS —— Magnesium Alloy Castings, Sand, 3.3Ce-2.5Zn-0.8Zr;

Please turn page

• AMS —— Magnesium Alloy Castings, Sand, 5Zn-0.7Zr;

• AMS —— Steel Tubing, Corrosion and Heat Resistant, 18Cr-11Ni (Cb + Ta) (SAE 30347), Hydraulic;

• AMS —— Steel Tubing, Corrosion and Heat Resistant, 18Cr-11Ni-Ti (SAE 30321), Hydraulic;

The approved specifications are:

• AMS 2410B—Silver Plating, Nickel Strike—High Bake;

• AMS 2412B—Silver Plating, Copper Strike—Low Bake;

• AMS 2645C—Fluorescent Penetrant Inspection;

• AMS 2646—Contrast Dye Penetrant Inspection;

• AMS 3232G—Asbestos and Synthetic Rubber Sheet, Hot Oil Resistant;

• AMS 4701B—Copper Wire, Annealed;

• AMS 4816—Bearings, Silver Clad Steel Strip;

• AMS 5521B—Steel Sheet and Strip, Corrosion and Heat Resistant;

• AMS 5646D—Steel, Corrosion and Heat Resistant;

• AMS 5651C—Steel, Corrosion and Heat Resistant;

• AMS 7240B—Washers, Spring Lock;

• AMS 7260—Rings, Packing, Synthetic Rubber, Fuel and Low Temperature Resistant;

• AMS 7232A—Gaskets, Type XX Engine Accessory Drive, Corrosion Resistant Steel Screen Reinforced;

• AMS 7310C—Piston Rings, Cast Iron.

Panel Meets to Draft Identification Marking Proposal

THE group shown here assembled to work on a standardization document on the identification of parts, assemblies, and equipment for aircraft powerplants.

It is part of the Identification Marking Panel of Committee E-21, General Standards for Aircraft Engines of the SAE Aeronautics Committee. The panel has met 11 meeting days.

Its purpose is to provide a guide to marking items adequately, without damaging them. Engine parts are marked at various points in their processing by different departments and companies. Some of the markings must be permanent to satisfy the requirements of government agencies that a part in the field must be traceable back to its fabricator and even to the producer of the material.

The Panel is trying to produce a document that will allow vendors and inspectors to use the most economical marking method after the design engineer has indicated the location of the mark and the maximum severity of mark the part can stand. This is to be accomplished by listing suitable alternates to various marking methods.

Methods all the way from embossing the metal by heavy stamping to rubber stamping and tagging the part have been studied for their suitability to various uses.

Also included in the document will be marking definitions and recommendations on limits of depth of markings, the panel intends.

Photographed on a tour of the Pratt & Whitney Aircraft plant in East Hartford are these members and consultants of the Identification Marking Panel and three PW&A employees serving as tour guides: W. Moskowitz, General Electric; J. Sohn, Wright Aeronautical; T. Arnold, Wright Aeronautical; J. Flaker, Lycoming; P. Murphy (tour guide); K. S. Barrett, Pratt & Whitney Aircraft; D. L. Power, Allison; N. F. Rooke, Pratt & Whitney Aircraft; M. Kashmann (tour guide); D. L. Seidel, Westinghouse; R. E. Shmalberg, Westinghouse; Panel Chairman H. B. Slusher, General Electric; A. M. Smith, Pratt & Whitney Aircraft; and W. Hadden (tour guide). Not around when picture was taken were R. F. Schwarzwalder, Wright Aeronautical; D. L. Kidd, Aircooled Motors; J. C. Squiers, Continental Aviation & Engineering; and T. E. Coon, Packard

Designing an Oil to Please the Modern Engine

Based on paper by

LEONARD RAYMOND,

Socony-Vacuum Oil Co.

and

J. F. SOCOLOFSKY,

Socony-Vacuum Laboratories

MORE powerful and efficient gasoline engines now in production and in prospect have created new lubricating oil problems and intensified old ones. It is essential, therefore, to have engine oils not only with improved performance properties, but having new qualities if maximum performance and protection are to be obtained with these new engines.

To develop an oil which would meet present-day needs, a program was undertaken which sought four major objectives. These were:

1—Reduced knock, preignition, and spark plug misfiring.

2—Reduced mechanical and corrosive wear.

3—Increased engine cleanliness.

4—Improved viscosity, volatility and pour point characteristics to achieve the combination of low oil consumption at high temperatures, easy starting at low temperatures, and improved fuel economy.

Early in this work it became apparent that engine make and operating conditions have a significant effect on the formation of combustion chamber deposits. Data has been provided by other experimenters which show a range in octane number requirement increase (ONRI) from 4½ numbers to 12 numbers for three different makes of cars. And the effect of driving conditions is shown in Fig. 1 where ONRI is plotted against miles per year. Here, the cars with the lower yearly mileages have the higher ONRI, reflecting the probable influence of short-trip operation on combustion chamber deposit buildup.

These and other data illustrate the variations arising from differences in engines and operating conditions. They prove conclusively that fuels and lubricants can affect significantly combustion chamber deposits and the combustion phenomena of knock and preignition which are of so much concern. At this point, therefore, an attempt was made to segregate the influence of the lubricant by investigating the effect of all distillate versus distillate-bright stock blends and of oil viscosity.

We found a considerable increase in ONRI with increasing bright stock content and viscosity. Increasing percentages of bright stock lead to higher carbon-lead salt ratios in the deposit. It is theorized that the higher proportion of carbonaceous material is re-

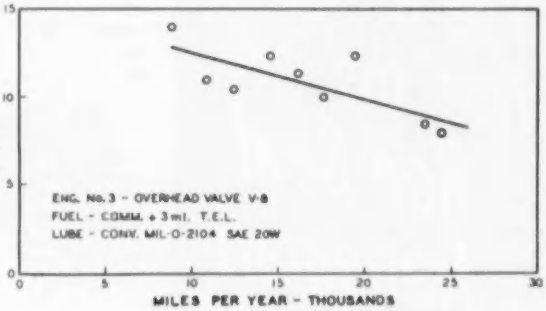


Fig. 1—The penalties of short trip operation in the form of combustion chamber buildup are severe. With lower mileage goes higher ONRI.

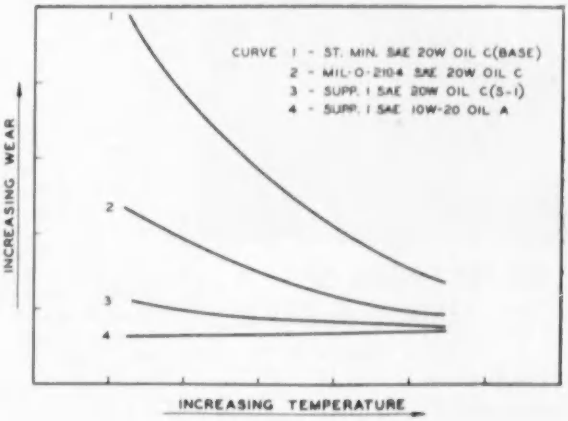


Fig. 2—Radio-active engine wear tests show that with conventional oils wear increases appreciably with decreasing temperatures. At lower temperatures there is a large difference in wear protection afforded by straight mineral oil and MIL-0-2104.

Editorial Correction

An editorial error was made in the Golden Anniversary article by P. B. Taylor, "The First 100 Years of Aircraft Powerplants," which was published in the February, 1955 issue of SAE Journal.

On Page 94 of the issue, the first sentence in bold type in the first paragraph said:

> **"While the turbojet is being limited as previously stated to about 4500 hp, the turboprop has no such limit."**

The way it should have read, and the way in which it appeared in Taylor's manuscript, is as follows:

> **"While the latter (the reciprocating engine) is being limited as previously stated to around 4500 hp, the turboprop has no such limit."**

sponsible for the higher ONRI observed. This effect of bright stock is also revealed in data in which straight mineral oils are compared. The SAE 10W and SAE 30 grade distillates show 0 and 1 ONRI, respectively, while the SAE 30 blend of distillate and bright stock gives an ONRI of 7. Both laboratory and road data show similar trends.

Because the objectives of reduced wear and increased cleanliness presupposes higher additive concentrations, the influence of additive concentrations on ONRI was studied. The data obtained indicate no significant effect of detergent concentrations on ONRI when using commercial gasoline containing 3 ml TEL/gal. However, with unleaded alkylate, the nondetergent oil gave a much lower ONRI than a Series 2 oil. It is our conclusion that generalizations on the effect of additives are probably premature and that individual results may differ depending on the particular base stocks, additives, engines, fuels and test conditions.

Keeping in mind the four major objectives, an oil was formulated which comprised a blend of selected distillate oils plus a combination of V.I. improvers and a new detergent-inhibitor combination. When this new formulation, known as Oil A, is compared with more conventional products to illustrate its effect on ONRI, we find the new cross-graded product shows a consistent and relatively large gain in reduced ONRI over SAE 10W and SAE 20W lubricants, the average reduction being more than three octane numbers. In general, Oil A shows a small advantage over SAE 5W-20 oil. Thus the new oil represents a major gain in reduced ONRI, at one time thought impossible to accomplish through lubricating oil. Considerable room for improvement remains and will continue to be the target of major effort.

Of immediate importance, although not of greater long range consequence, is the effect of the change to the new oil in a "carboned" engine, without any reconditioning. The reduction in ONR is consistent and significant, the average reduction being approximately three numbers, while the largest gain is 9 octane numbers. In some cases substantial decrease in ONR occurred in relatively short mileages after change. The number of cars of any one make used in the tests was too small to permit detection of a trend in the magnitude of the reduction of ONR by make of car.

Laboratory test data comparing Oil A to conventional type SAE 20W show that Oil A gave a much lower preignition requirement in one engine, a great reduction in the incidence of preignition in another, and complete elimination of wild ping in a third. Road test data showed Oil A had an advantage in several forms of uncontrolled combustion including reduced knock as shown by lower ONRI, fewer wild pings, and no after-running. Both laboratory and field tests show Oil A having a more rapid and larger effect on preignition than on knock.

Mechanical Wear

While published data indicate that viscosity has a measurable effect on wear and scuffing under boundary lubricating conditions, it appears to be a relatively small factor which can be far outweighed by the influence of selected additives. Comparison of the performance of different oil-additive combinations in two engines indicates that a lubricant which gives good protection in one engine is not necessarily satisfactory in another, and that the order of merit of a series of lubricants can vary from engine to engine. This confirms the observations of other laboratories. Oil A appears to have the ability to protect both engines adequately under boundary lubrication conditions.

In view of the differences in behavior of different engines with a common series of lubricants, it would be too much to expect that any given antiwear or anti-scuff bench test developed for another purpose would predict performance in any engine. For this reason, unwise reliance on bench tests can be an expensive, time consuming and unproductive attempt at a shortcut.

Corrosive Wear

A survey of car use, conducted in 1951, found that 38% of all trips were for less than three miles one way and 63% for less than six miles one way. These short trips do not permit jacket temperatures high enough to prevent condensation of corrosive combustion products on the ring and cylinder surfaces and thus wear is accelerated.

Wear data over a range of temperatures for four oils differing in viscosity characteristics and additive level are shown in Fig. 2. Note that with conventional oils, wear increases appreciably with decreasing temperature; at lower temperatures, there is a large difference in the wear protection afforded by a straight mineral oil and by a MIL-0-2104 oil of conventional base stock formulation. Increasing the additive dosage of the latter to the Supplemental List 1 level shows a further decrease in wear rate. Comparison of curves 3 and 4 indicates that cross-graded Oil A, with its lower viscosity at low temperatures, gives lower wear than conventional SAE 20W of like additive content. Field performance data are believed to support the temperature effects on wear shown in the laboratory.

Engine Cleanliness

In short trip driving, the lower temperatures and low load factor of higher horsepower engines are productive of deposits arising from rich mixture operation and incomplete combustion of the fuel. On the other hand, the closer clearances of these engines demand greater protection against deposits of varnish and sludge forming materials. The solution to the protection problem demands additives which are more effective in preventing the formation, agglomeration and deposition of such harmful products.

Following an extensive program in-

volving cleanliness evaluations in a variety of engines in addition to the usual Caterpillar L-1 and Chevrolet FL-2 type tests of detergency, a new type additive combination was developed which has proved very effective in Oil A.

Low Temperature Starting and Oil Consumption

The oil industry has been paying great attention to cross-grading or the increase in viscosity index which permits one oil to span two or more SAE viscosity grades. At present, it is difficult to formulate a practical 5W-30 oil due to technical limitations and cost considerations. Since commercially available SAE 5W-20 oils appear to suffer from high oil consumption while the SAE 10W-30 oils appear to be deficient in low temperature properties, the manufacturer who wishes to market a single cross-graded oil for all cars under all conditions in all areas finds himself in a dilemma. One way to resolve it is to start with the premise that the engine does not recognize SAE numbers and base the selection of the preferred viscosity range on engine performance data and engine requirements.

The selection of the viscosity range of any oil, conventional or cross-graded, is a matter of individual choice based on technical and commercial considerations. Analysis of low temperature starting and oil consumption data led us to conclude that a viscosity range of approximately 7000 SUS at 0 F and 55 SUS and 210 F would cover the requirements of all but a very small part of the cars in this country.

In time, we may have a single oil covering the complete range of starting and oil consumption requirements. But until that time arrives, it would seem best to emphasize engine requirements rather than SAE numbers in arriving at the preferred viscosity range.

(Paper "Designing New Performance into a New Special Oil" was presented at SAE Summer Meeting, Atlantic City, June 9, 1954. It is available in full in multilithographed form from SAE Special Publications Department. Price: 35¢ to members, 60¢ to nonmembers).

Jet Engine Exhaust Looms as Big Problem

Based on paper by

ROBERT L. NORDLI

Wright Air Development Center

THE exhaust system and associated items will present one of the major installation problems on all high performance aircraft whether afterburner or tailpipe is used. And the problem will become worse before it becomes better.

Some current non-burner installa-

NOW . . .

3 Advertising Counselors

SAE JOURNAL HAS ADDED . . .

. . . a new advertising sales office in Chicago. It will continue its offices in Detroit and New York. This expansion puts three able counselors at the service of advertisers to the automotive and aeronautic industries.

New York 29 W. 39th Street

Edward D. Boyer

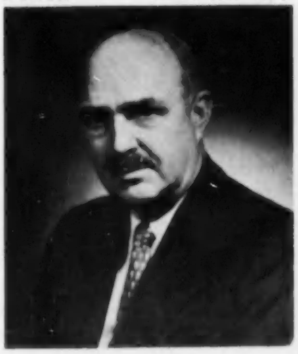
TEN years of successful advertising sales experience, backed by a previous decade of sales achievement in industry enables Mr. Boyer to bring automotive advertisers a wealth of practical help on their marketing problems.

For many years he has been an active participant in the committee work of the National Industrial Advertisers Association. There he has contributed to the cooperative efforts of this important organization.

As Eastern Advertising Manager for Progressive Architecture, he was thoroughly familiar with the problems of industrial advertisers in the Eastern part of the country.

His more recent association with the Society of Automotive Engineers has brought him into intimate contact with the special problems of those aiming to reach the automobile and aeronautic industries.

Detroit 3-210 G.M. Bldg.



A. J. Underwood

IN charge of SAE Journal's Detroit office since 1933, Mr. Underwood is exceptionally equipped to counsel on problems of automotive marketing.

A graduate in electrical engineering from Yale's Sheffield Scientific School, he was actively engaged in engineering work for many years before entering the advertising sales field.

As a sales engineer at Hyatt Roller Bearing Co. he gained valuable marketing experience. Later as an executive in the standards department of the Society of Automotive Engineers headquarters staff, he was long concerned with the application of automotive products of every kind.

While at SAE headquarters, he played a prominent part in development of SAE's aeronautical program, which now spans the interests of nearly half of the Society's 20,000 members.

Chicago 7530 Sheridan Road

William W. Milne

NINE years in charge of SAE's constantly growing program of Engineering Displays has brought Mr. Milne close to the marketing needs of many automotive advertisers.

Functioning also as business manager of SAE's Meetings Division, he has gained an intimate personal contact with the engineers and production men who make up the membership of the Society of Automotive Engineers, all of whom are readers of the SAE Journal.

Previous to his association with SAE, Mr. Milne held responsible posts in the public relations departments of General Motors Corp. and its Fisher Body Division.

A few years ago, he was responsible for the staff operating phases of SAE's successful Technical Air Review, in which hundreds of the newest aircraft were assembled under SAE auspices.

tions have a tailpipe with a simple circular nozzle with possibly some provision for tabs to be attached to adjust the nozzle outlet area within a few square inches above and below design for standard conditions. Afterburner engines require a method of varying the nozzle exit area to permit increased thrust without exceeding internal pressure and temperature limitations.

To obtain supersonic gas flows for high performance supersonic aircraft a suitable convergent-divergent flow area must be provided. Thrust reversers are currently being developed which will be installed eventually on nearly all jet engine propelled aircraft and probably will be located at the nozzle. There is also an ever increasing need for other directional control features for aircraft during ground roll on icy or wet runways. This control can be obtained by deviating the exhaust gas flow from its normal path.

Currently, there are considerations for other items and configurations at the nozzle to obtain other desired results. Obtaining a configuration incorporating all these features plus providing for installation of an insulation blanket or an ejector shroud within the available fuselage area, having a low base drag for the entire installation, is going to require a few years of concentrated design effort. The nozzle configuration not only becomes complex but the control and actuation system installation renders a major problem. (Paper "The Installation Barrier" was presented at SAE Los Angeles Aeronautic Meeting, Oct. 7, 1954. It is available in full in multilithographed form from SAE Special Publications Department. Price: 35¢ to members, 60¢ to nonmembers.)

Based on Discussion

Edward Vernon Albert, General Electric Co., Aircraft Gas Turbine Div.

What are the quantitative features of the thrust reversal system tested on the F-84F as regards—percentage of reversal recovered, time to release reverse thrust from a full rearward to a full forward position, and any difficulty with the effect of hot gases on the aircraft structure?

Mr. Nordli:

In the F-84F test configuration an effort was made to keep the thrust loss caused by the reversal device to a maximum of 5%. Base drag was to be kept at a minimum and the device was to be retractable out of the gas and air stream. In this case the aerodynamic reverser is paramount with losses held to below 1%.

An objective was to have the reversal device fully actuated within two seconds, although this time limitation is controversial, and in some cases it may run higher to actuate.

Heat of the structure during thrust reversal is a real problem at low speeds but the effect becomes less prominent at higher speeds. Surface heating of the airframe structure is also limited by less turning.

SP News About Special Publications

Men with a mission, a challenge, and faith in themselves and their future. That's "The SAE Story" of its first 50 years. This new history of the Society, just completed on the occasion of this Golden Anniversary year, is now available.

It's a living story of the aspirations of men with vision, the trials and tribulations of pioneering, and the rich rewards from dedication to service.

You'll understand and appreciate your Society better by reading this chronicle of SAE's first 50 years.

If you want a copy, order SP-136 from SAE Special Publications Department. It's priced at $2.00 to members, $4.00 to nonmembers.

* * * * *

HAVE YOU SEEN the new list of CRC reports currently available through SAE? If not, turn to page 96.

Reports issued by the Coordinating Research Council cover the broad area of vehicle-fuel-lubricant relationships. You'll find in them a wealth of research data . . . *findings produced by hundreds of researchers working in scores of automotive and petroleum laboratories.*

* * * * *

YOUR CHECKLIST of papers to be presented at the SAE GOLDEN ANNIVERSARY NATIONAL AERONAUTIC MEETING will be mailed to you in a few days. It's a convenient form on which to order the preprints you want. It will accompany the program for the Meeting.

A similar form is sent to you with *each* program for an SAE national meeting. So, if you can't attend a meeting to hear the papers of interest to you, order them from SAE Special Publications Department. Many preprints will reach you even before presentation of the papers at the Meeting.

* * * * *

Still available—Part 1 of ENGINEERING KNOW-HOW IN ENGINE DESIGN. Listed as SP-119, Part 1, as Part 2, grew out of a lecture series by leading design engineers on the fundamentals of engine design. It is available to members for $3.00 and to nonmembers for $7.50.

About SAE Members

continued from page 77

JAMES J. POWLAS, previously field engineer, Automotive Division of Wagner Electric Corp., St. Louis, Mo., is now associated with Bendix Products Division, Bendix Aviation Corp. as engineer-technician.

JAMES W. McGUFFEY, who was manager of Truformed Tubes, Lansing, Mich., is now associated with Tranter Mfg., Inc. of Lansing as assistant chief engineer.

TRYGVE VIGMOSTAD is superintendent-engineering with the Automotive Body Division, Chrysler Corp. He was formerly connected with the Briggs Mfg. Co. as an experimental engineer.

CHARLES C. SONS, JR. formerly on special assignment to general manager of the GMC Truck & Coach Division, is now vice-president and service manager with the Min-A-Con Equipment Co., Phoenix, Arizona.

KEITH L. ROBERTSON, previously assistant maintenance superintendent, has become maintenance supervisor with the Peter Kiewit Sons' Co., Arcadia, Calif.

B. FRANK JONES is now chief engineer with White Motor Car Co. of Canada, Ltd., Montreal, Que. He had served in the same capacity with the Autocar Division of White Motor Co. in Exton, Pa.

KENITH GOODRICH STRUNK has accepted the position of project manager with A. M. Kinney, Inc., Consulting Engineers. He was formerly connected with the Hope Electrical Products Co., Newark, New Jersey.

ROBERT F. SMALL has joined the Le Tourneau Westinghouse Corp., Peoria, Ill. as design engineer. He had served in the same capacity with Kenworth Motor Truck Corp. in Seattle.

LLOYD JAMES VERKET is now an associate engineer with the Douglas Aircraft Co., Santa Monica. He was previously with the USAF Air Materiel Command, Hill Air Force Base, Ogden, Utah.

J. W. BUCKLEY has joined the Dodge Truck Division of Chrysler Corp. and is functioning as a staff engineer. Buckley was chief test engineer with Reo Motors, Inc.

About SAE Members

continued

DONALD E. FERRO, formerly junior project engineer with Clark Equipment Co., has taken a position with Bendix Products Division, Bendix Aviation Corp. as a service engineer.

ROBERT A. PETERSEN is now serving as project engineer with American Motors Corp., Hudson Motors Division. With Marco Mfg. Co., Wheatland, Pa., he had served in the position of chief engineer.

CLAIR M. CRISPEN, formerly field engineer with Chrysler Airtemp Sales Corp., Dayton, Ohio, has taken a position as sales engineer with American Furnace Co., St. Louis, Mo.

WILLIAM L. PRINGLE has been made sales manager of the Long Mfg. Division of Borg-Warner Corp. He formerly was assistant chief engineer of Timken Detroit Axle Co.

RICHARD E. BERGER is now a research engineer at North American Aviation, Inc., Columbus, Ohio. He had been serving in the Warranty Claims Division, Service Department, Caterpillar Tractor Co.

FRANK L. MILLS, previously chief draftsman for Willys Motors, Inc. of Toledo, is now serving in the same position with the M. C. Mfg. Co., Lake Orion, Mich.

WALDEN P. WEAVER has joined the Briggs & Stratton Corp. as an engineer in the Sales-Service Department. He was formerly with the Pure Oil Co. as staff engineer.

OTIS A. SCHMIDT has become president and owner of American Ornamental Iron, Chicago. He was sales manager of Broadview Iron Shop, Inc., La Grange, Ill.

RALPH W. De LUCA, has been promoted to the position of branch manager by Cummins Diesel Engines, Inc. in Philadelphia. He had served as sales engineer.

A. G. BARTLETT, formerly manager of gasoline sales with Texas Natural Gasoline Corp., Tulsa, has become associated with Suntide Refining Co. of Corpus Christi, Texas as general sales manager.

ALLEN W. CHURCH is now associated with the Trackson Co., a subsidiary of Caterpillar Tractor Co. in Milwaukee, Wis. He was service engineer with Le Roi Co., subsidiary of Westinghouse Air Brake Co.

EDGAR R. JORDAN, previously senior design engineer with Scott-Atwater Mfg. Co., Minneapolis, Minn., is now serving as project development engineer for the Oliver Corp., Outboard Motor Division, Battle Creek, Mich.

CHENG SHIH is now associated with the Electric Auto-Lite Co. of Toledo as project engineer. He was research engineer for Kiekhafer Aeromarine Motors, Inc. of Fond du Lac, Wis.

J. H. SMITHSON, formerly development engineer with the Celanese Corp. of America, has become manager of the Economic Evaluation Department, Canadian Chemical Co., Ltd., Montreal.

ELDON WILLIARD TIBBITS, formerly a dynamometer engineer with Reo Motors, Inc., is now a project engineer with Continental Aviation & Engineering, Detroit.

BURTON D. JONES, formerly development engineer with Aircooled Motors, Inc. of Syracuse, N. Y., now holds the same position with the Engineering Division of Chrysler Corp. in Highland Park, Mich.

J. S. PARKER has been appointed general manager of the General Electric Co.'s Aircraft Gas Turbine Division. Until this appointment, Parker had been manager of the Small Aircraft Engine Department, Lynn, Mass.

RANDOLPH J. ROSHIRT has been elected to the position of executive vice-president of Aluminum Industries, Inc. He had been vice-president at Aluminum Industries since May, 1953.

GROVER C. MELLIN, JR. is now junior engineer with Detroit Diesel Division of General Motors Corp. He had been trainee engineer for Cummins Engine Co., Inc. of Columbus, Ind.

New Members Qualified

These applicants qualified for admission to the Society between January 10, 1955 and February 10, 1955. Grades of membership are: (M) Member; (A) Associate; (J) Junior.

Alberta Group

John Graham Bruce (A), Norman George Moreland (A).

Atlanta Section

Stephen N. Bean (M), Albert D. Brown (M), F. A. Buchanan, Jr. (A), William E. Fike (A), Reginald R. Kearton (M), James B. Robinson (M), Earl J. Tuttle, Jr. (A), David E. Walker (M).

Baltimore Section

Robert R. Anthony (A), Lt. Arthur Bross (J), Kay A. Estes (J).

Buffalo Section

William M. Bradley (M), James S. Entringer (M), George F. Kappelt (M), Wesley Frederick Kofahl (J), Charles Richard Williams (J).

Canadian Section

Ernest R. Chown (A), George M. Hood (M), Darius Irani (J).

Central Illinois Section

Herman J. Eppink (M), Harold D. Harms (J), Walter I. Nelson, Jr. (J), William E. Parker (J), James R. Sebern (M), Herbert L. Vernon (M), Clifton Weaver, Jr. (J), Gerald A. Wempner (J).

Chicago Section

Peter D. Aravosis (J), Earle S. Batchelor (M), Bansun Chang (M), Roy F. Dodgen (M), Franklyn B. Fullmer (M), Sidney F. Graham (M), Edward F. Jolyk (M), Hubert D. Minnis (A), Paul F. Niessen (M), Glenn M. Peterson (M), James F. Schell (J), Harold E. Surface (J).

Cincinnati Section

F. Douglas Baker (M), Leo Donald Couch (J), Raymond L. Grismer, Jr. (M), F. P. Waldmann (A), J. Duane Wethe (M).

Cleveland Section

Charles L. Driscoll (M), Russel Philip Gantos (M), Bruce E. Hutchins (J), Harold R. Scibbe (M), Benjamin A. Slupek (J), Clarence R. VanNiel (A), Walter P. Wright (J).

Colorado Group

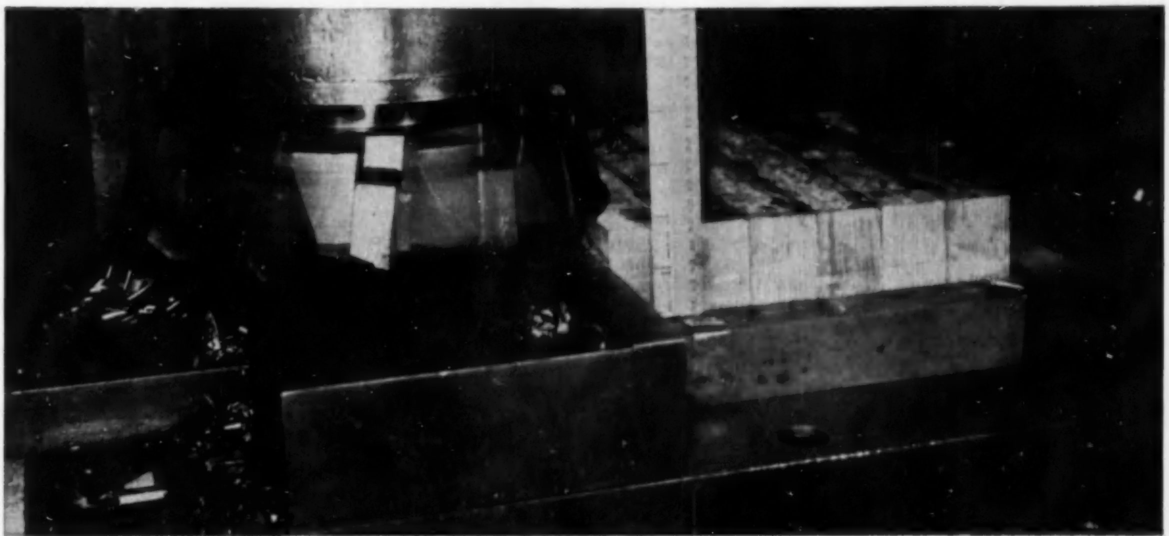
Donald I. Stahl (J).

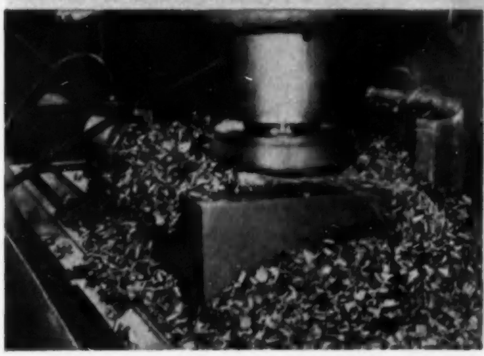
Dayton Section

James W. Day (J), James W. Jacobs (M).

Detroit Section

Peter Reginald Angell (M), John Arko (A), Charles F. Baldwin, Jr. (A), Richard J. Bernock (A), James G. Berry (M), Arthur E. Bishop (M), Eugene L. Boyce (M), Paul Dehn Carleton (J), Edward J. Clarke (M), Daniel Joseph Czolgosz (J), Dennis A. Davis (J), Joseph Ricardo de Martino (M), Charles C. Dempsey (A), John F. Devine (J), John A. Ellis (J), Walter S. Fagley, Jr. (J), Max Fingeroot (M), Fred J. Finkenauer, Jr. (M), Earl L. Fleming (M), John S. French (A), Edgar R. Frost (A), William B. Gordon (J), Louis Grabill (J), Lawrence Roger Green (J), Charles W. Greening (J), Lawrence Joseph Heiser (J), Olaf S. Helland (J), Carl John Holdampf (J), James Gerald Hunt (J), Henry B.





New Members Qualified

continued

Hutten, Jr. (M), Robert A. Jeffries (J), Duke S. Johnson (J), Theodore A. Kamrath (J), M. L. Katke (M), James Stuart Kawsky (J), Alonzo H. Kelly, Jr. (M), Robert John Keyes (J), Jack B. King (J), Stanley F. King (J), Gilbert G. Kurop (J), Charles R. Lautz, Jr. (J), Harold A. Little (J), Richard W. Longley (M), Edward A. Macholl (M), John I. Manecke (M), Thomas L. McCarthy (M), Stanley H. Mick (J), Elroy E. Newlon (A), Fred Onkalo, Jr. (J), Irving C. Peterson (M), Leo V. Peterson (J), Albert Rae Pitton (J), Donald J. Pulk (A), Gene F. Riegler (J), Chester J. Selden (M), Joseph F. Smiley (J), George A. Sparks (M), Adolph P. Speth (J), Charles B. Steger (J), Andrew G. Swords (M), Sylvester T. Tafelski (M), A. Roger Tyslan (J), George M. Vanator (M), Roger Voorhees (J), Louis Weberman (J), Burton A. Wilson (J).

Indiana Section

James A. Acker (J), Ray Franklin Gong (J), Albert Michael Mikolajczyk (J), Albert Salatka (A), Frank M. Watson (M).

Kansas City Section

Wayne M. McCann (A).

Metropolitan Section

Herschel V. Beasley (M), Joel Blatt (J), Louis J. Campanelli, Jr. (A), Douglas Campbell (M), Donald B. Capwell (J), Franklin A. Cirino (J), Alexander DeStanko (A), Roy Ehnhuus (J), Constantino Formicola (J), William J. Frick (M), Richard J. George (A), Willard C. Hass (A), John G. Keller (M), August C. Kellermann (A), Carlton S. Kelly (M), S. Howard Lagerveld (M), Nicholas George Lassios (J), Charles John Malone (A), Bernard P. McPeck (A), Charles L. Meserve (M), Capt. Samuel Hudson Miller (M), Maurice B. Rice (M), Lawrence Howard Rosenthal (J), Herbert Schulz (M), Frank A. Van Hoy (J), John Frederick Werner (J).

Mid-Continent Section

Harold W. Torgeson (M).

Mid-Michigan Section

James H. Diener (M), Robert J. Grills (J), Fred Miller (J), James D. Pidd (J), Byron Frank Trenchard (J), Ernest O. Vahala (J), William R. Zeeb (M).

Milwaukee Section

Aldo Celli (M), Roger B. Hunter (J), Eugene L. Nelson (M), Robert H. Reineck (A), Donald J. Seaman, Jr. (J), Zach Earl Taylor (J), Carl F. Thelin (J).

Montreal Section

H. W. Drescher (M), Marc J. Marceau (M), William J. Riley (M).

New England Section

Everett Linwood Caswell, Jr. (J), Russell L. Valentine (M).

Northern California Section

Arthur L. Andrew (J), Charles R. Coffey (M), Lester M. Hartmann (M), Burton W. Long (J), Joseph Mednick (M), W. C. Mentzer (M).

Northwest Section

James Ross Brown (A), Robert D. Lowe (J), Howard Ernest Ostrin (J), Roderic C. Sowell (J).

Oregon Section

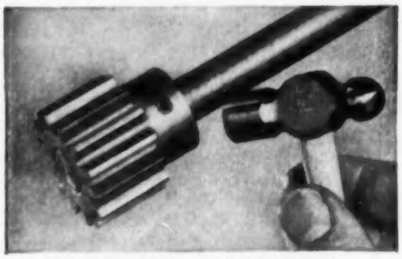
James P. Bates (M), Lloyd Alfred Doughty (A), James Joseph Hill (J).

Where can you use this simple fastener?

No threading, peening or precision drilling with ROLLPIN

Rollpin is driven into holes drilled to normal production-line tolerances.

It compresses as driven.



Rollpin fits flush . . . is vibration-proof.

Rollpin is the slotted tubular steel pin with chamfered ends that is cutting production and maintenance costs in every class of industry.

This modern fastener drives easily into standard holes, compressing as driven. Its spring action locks it in place—regardless of impact loading, stress reversals or severe vibration. Rollpin is readily removable and can be re-used in the same hole.

* * *

If you use locating dowels, hinge pins, rivets, set screws—or straight, knurled, tapered or cotter type pins—Rollpin can cut your costs. Mail our coupon for design information.

Dept. R16-375, Elastic Stop Nut Corporation of America
2330 Vauxhall Road, Union, New Jersey

Please send me the following free fastening information:

☐ Rollpin bulletin
☐ Elastic Stop Nut bulletin
☐ Here is a drawing of our product. What fastener would you suggest?

Name ________ Title ________

Firm ________

Street ________

City ________ Zone ____ State ____

New Members Qualified

continued

Philadelphia Section

Jack W. Cotton (J), Edward L. Dold (J), Oscar W. Ehrman, Jr. (J), Daniel J. Featherman (J), David Lantz Gamble (M), Robert G. Hardin (J), Otto F. Licht (M), John O. Lutz (M), Alexander A. Mittenbergs (M), Jack Robert Schaefer (A), George C. Watson (M).

Pittsburgh Section

Roland Bliss Sickler (J), LeRoy B. Thompson (J).

St. Louis Section

John T. Ellerman (M), Frank Perry Gross, Jr. (J), Richard C. Hugo (M), Ray E. Kessler (M), Stanley A. Loring, Jr. (J), Joseph Wiskirchen (J).

Salt Lake City Group

Myles Richard Burns (J), Wilmer A. Spitzer (M).

San Diego Section

Richard William Cihak (J), James William Creel (M), Charles E. Phillips (J), Farrell Tipton (M), Robert F. Wimble (A).

Southern California Section

Lucas L. Akana (J), William L. Boren (J), Harry S. Brenner (M), Paul F. Brunner (M), Randolph B. Burbank (J), Donald R. Clarke (M), Osborne John Fagan (J), William R. Frank (M), Robert L. Franzen (J), Robert Edward Gillingham (J), Charles Clifford Griffin (J), Ollie R. Harrison (A), Jerry D. Hester (M), Richard Allen Hudson (J), Leslie J. Jacobson (J), Gustav Victor Johnson, Jr. (J), June H. Katow (J), John M. Lipscomb (A), Robert Edgar Lockwood (J), F. H. Markley (M), Charles M. Moreaux (J), John Seldon Ogle (J), Douglas P. Pedersen (M), Andrew C. Sherwin (M), Jack E. Styers (M), Henry W. Upton (A), William B. White (M).

Southern New England Section

Carl Edward Cousineau (J), James J. Ford (A), Alfred Gianni (J), M. Andrew Melnick (A), Jack Shirlay Miller (J), James F. Olsen, Jr. (J), Harold Daniel Stetson (J).

Syracuse Section

David D. Carrington (J).

Texas Section

John E. Ginn (J), Wayne Q. Hanson (J), Bill R. Lewis (A), William David Reid (J).

"Let's be sure to specify STEERING LINKAGE BY THOMPSON"

MORE and more automotive manufacturers today specify "Steering Linkage by Thompson" when designing and planning their cars, trucks, buses and tractors of tomorrow.

And for good reason—for they've learned that "You Can Count on Thompson" as a dependable source of supply. And they've learned, too, to count on Thompson for important developments in ball joint design, for steering linkage, as well as other applications. Thompson's steering linkage units are in yesterday's cars and today's cars. And they'll be in tomorrow's cars, too.

Typical of these developments is the revolutionary Thompson-engineered front suspension ball joints, the greatest advance in automotive front suspension in 20 years. For over 50 years Thompson has played an important role in the automotive world.

If you use steering linkage assemblies, specify "Steering Linkage by Thompson". For details on how Thompson's skilled steering engineers can help you with your steering linkage developments, write, wire or phone Thompson Products, Inc., Michigan Div., 7881 Conant Ave., Detroit 11, Michigan, WA 1-5010.

Thompson Products

MICHIGAN DIVISION

DETROIT • FRUITPORT • PORTLAND

New Members Qualified

continued

Texas Gulf Coast Section

Tom Ferris (A), Walter K. Morris (M), Irwin Palmer (J), O. P. Puryear (M).

Twin City Section

Arthur Richard Berg (M), John P. Ullrich, Jr. (J), Orwin C. Youngquist (M).

Washington Section

David E. Guthrie, Jr. (J).

Western Michigan Section

Ray O. Smith (A).

Williamsport Section

James F. Hartman (M).

Outside Section Territory

Bobby J. Chapman (A), Ronald L. Frontroth (J), Jacob P. Gardner (M), Wayne Alan Hahne (J), Russell Hastings, Jr. (M), C. E. Hoover (A), Donald F. Langenderfer (M), William Paul Moore (J), John W. Phillips, Jr. (A), Conrad Teichert, Jr. (J), Lt. Col. Layton C. Tyner (M), Thomas Gregory Wier (J).

Foreign

K. S. Balakrishnan (J), India; Lt. Col. David Vere Goland (M), Australia; Sydney Hyde Kemsley (A), Bermuda; Manfred O. Kluth (J), Germany; George Krause (M), Switzerland; Trevor Victor Krok (M), Australia; James McAvoy (M), Scotland; John Stephen Patin (J), Haiti; Ivan Karl Stolzenberg (M), Australia.

Applications Received

The applications for membership received between January 10, 1955 and February 10, 1955 are listed below.

Atlanta Section

Jeff D. Andrews, William R. Harper, Ben Ralph Haverstick, Frank S. Jarrett.

Baltimore Section

David M. Hall, Harvey R. Miller.

Buffalo Section

Henry S. Maday.

Canadian Section

Charles H. Barrett, John R. Murdock, Wilfred G. Whitehouse.

Central Illinois Section

Andrew B. Johnson, Paul C. Rosenberger.

Chicago Section

Harold L. Anson, Howard A. Heckendorf, Arthur R. Kernen, Jr., A. King McCord, LeRoy E. Ording, Earl C. Uban, Paul M. Uitti, Walter W. Whitlock, Harold R. Johnson, Jr.

Cincinnati Section

L. L. Bushong, Charles R. Miller, H. Edgar Pitzer, Wray D. Simpson.

Cleveland Section

Thorp A. Andrews, Jr., Richard Bicknell, Charles Henick, Raymond E. Houser, Cecil L. Hunter, Michael Lacko, John J. Madigan, Stanley P. Ross, Robert W. Talder.

Applications Received

continued

Colorado Group

Edwin C. Marzinzik.

Dayton Section

Thomas F. Davidson, James E. McClelland, Jr., William C. Posey, W. R. Smith.

Detroit Section

Joseph F. Balgenorth, Joseph L. B. Bennett, Arthur Mark Brewer, Albert M. Bruder, David N. Buell, Richard B. Chapin, N. E. Chrisfield, Walter Chupa, Charles E. Cochran, Stanley D. Cockburn, Francis M. Coffey, Jr., J. S. Collman, Thomas C. Connor, George L. Corsi, Mortimer C. Crockett, Carl J. Demrick, Elias T. Diehl, George S. Ellis, Frank J. Esser, Archibald D. Evans, Royce E. Everett, Melvin M. Gerson, Ralph E. Glahn, Prescott L. Goud, Charles J. Griswold, Jr., Finn T. Halbo, William G. Hartmann, James H. Henry, Russell W. Hunter, Manfred A. Isaacson, Ferdinand L. Jesse, Lloyd A. Johnson, H. C. Kiefaber, Charles Kurland, Sydney E. Leese, James F. Leland, Robert Looker, Phillip H. Maxwell, James C. Miller, Jack E. Morgan, Lester V. Ostrander, Fred E. Parsons, Stewart R. Peebles, Knut S. Poppe, Robert A. Potter, William O. Robbins, Jesse A. Robinson, William A. Rosnyai, Peter S. Saigh, Eric B. Saward, Thomas C. Schultz, Walter L. Scott, Robert J. Shaver, Arthur J. Smolinski, Victor M. Teerlinck, Chi Mou Tsang, Rene H. Vansteenkiste, Harry R. Wolf, William R. Zehnder, George E. Kelm.

Indiana Section

Max G. Clingerman, Edward R. Hansz.

Kansas City Section

F. H. Ebbert, Frank W. Walkup.

Metropolitan Section

Jean R. Esquerre, Edwin L. Frost, William Grayer, Jack H. Kasley, Herschell W. Kelley, David Kravitz, David B. Kreider, Bert Lampe, John H. McCoy, John A. Misteli, Matthew J. Pastell, C. Anthony Ranieri, Harold L. Rounds, Leon B. Shore, Arthur W. Stewart, George Veder.

Mid-Continent Section

O. N. Thomas Fleig, William H. Hall.

Mid-Michigan Section

Victor V. Greening, Frederick W. Hyslop, Burton P. Miller, Leonard M. Morrish, Howard L. Roat, Harold J. Stanford, William E. vonKampen, Jack R. Wallace.

Applications Received

continued

Milwaukee Section

Joseph J. Birkenstock, George K. Isaacs, Gene E. Maeckel, Edgar L. McFerren, Gale E. Nordstrom, John W. Speaker.

Mohawk-Hudson Section

David S. Stark.

Montreal Section

William L. Bentley, Herbert E. Carter, Roland Dery, Norman L. Goddard, Lucien Guertin, Lorne Holtby, Desmond James, Ben Merson, William Sillar.

New England Section

Warren W. Houghton, Lewis H. Roosa, Hatherley A. Stoddard, Jr., David W. Weiss.

Northern California Section

Lloyd L. Davis, C. Dean Newnan, C. P. Johnson, Kenneth Krohncke, William M. Webb, Fred J. Wildanger.

Northwest Section

Harold R. Ginther.

Philadelphia Section

Salvatore F. Pisasale, Leon B. Rosseau, William Schreiber.

Pittsburgh Section

Robert L. Grun.

San Diego Section

F. Daniel Applegate, Adolph Bolger, Clarence A. Gerber, Ray Bert Kalanquin, L. E. Ottem, Theodore E. Sladek.

Southern California Section

Wayne W. Baughn, George W. Bowman, Jack M. Felker, Charles S. Glasgow, Jr., Ivan E. Gunton, John P. Klocksiem, Robert H. Merritt, Francis B. Murphy, Stanley C. Page, Frank A. Routa, Joseph F. Sanford, Sumner B. Sargent, John D. Watson, R. Stanley Wright.

Southern New England Section

John B. Beckwith, Thomas J. Gillick, Jr., Edmond H. Judd, John H. McCalla, Donald L. McCollum, Jr., Thomas G. McNamara, Winston H. Sharp, George V. Waradzin.

Spokane-Intermountain Section

Harold A. Brischle, William P. Eldenburg.

Texas Section

R. C. Donovan, Milton Green, Lyman C. Josephs, III, J. W. Larson.

Texas Gulf Coast Section

John C. Davis, Edwin C. Russell, Paul A. Tiffin, George Wilshusen.

Twin City Section

Russell R. Gutteridge, Michael Kaminsky, Jr., Sigurd A. Rishovd.

Virginia Section

Linwood W. White.

Washington Section

J. Pitts Jarvis, Jr., Benjamin S. Kelsey, Page M. Schmitt.

Western Michigan Section

Edsell M. Eady.

Outside of Section Territory

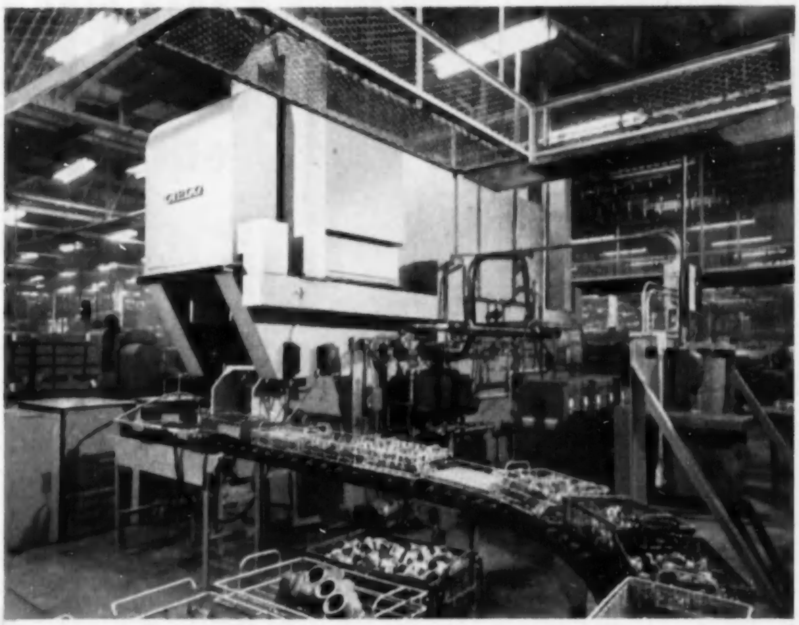
J. R. Allen, Vincent F. Burke, Carroll L. Cole, James F. Coyle, Clyde R. Gilbert, Donald L. Irwin, David S. Neuhart, Howard L. Pemberton, Hollis H. Travis.

Foreign

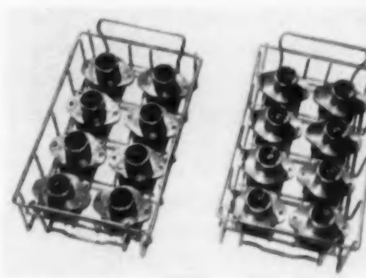
Raymond E. Donough, Borneo; H. Jose J. d'Ornellas, Peru; J. L. E. Groff, France; Kenneth A. Schuberg, India; Charles G. Tresidder, England; Feroze K. Viccaji, India.

WORLD'S LARGEST ULTRASONIC DEGREASER NOW ASSURES EVEN FINER *Safety* POWER STEERING

New Installation at Saginaw Steering Gear "Scrubs" Component Parts Microscopically Clean with 200,000 cps Ultrasonic Waves



Parts move through Saginaw's new Ultrasonic Degreaser at speeds from 1.7 to 4.8 feet per minute at Buena Vista Plant



Note startling transformation in appearance of parts (right) after ultrasonic cleaning

Hydraulic pumps, valves and other vital components of *Safety* Power Steering are now being assembled with a degree of cleanliness never before achieved in the automotive industry—thanks to the world's first application of ultrasonic degreasing to heavy mass production. The elimination of microscopic contamination before assembly will insure far less wear and longer trouble-free performance for closely-fitted *Safety* Power Steering parts operating under heavy hydraulic pressure.

In this new cleaning unit, 30 barium titanate transducers convert 200,000 cps alternating current into ultrasonic waves which violently agitate the molecules of a special degreasing solvent in which the parts are immersed. This creates a "scrubbing" action which removes even the most minute particles of dust, dirt, metal and grease from every recess. The complete operation is fully automatic as the parts are conveyed on carriers through preliminary cleaning, final ultrasonic cleaning, rinsing and vapor drying. The solvent is constantly filtered, distilled and re-used.

This pioneering quality advancement is proof again that the familiar Saginaw "S" stands for *superior* facilities, know-how and *service* to the automotive and aviation industries. How may we help *you*?

WORLD'S LARGEST BUILDER OF POWER AND MANUAL STEERING GEARS

Saginaw

STEERING GEAR DIVISION

GENERAL MOTORS CORPORATION • SAGINAW, MICHIGAN

When fast starts mean lives or dollars –

Globe  batteries are on the job

...EVERY TIME!

The same battery performance that helps save lives in emergencies . . . that saves dollars for heavy machinery users . . . proves best for automotive equipment! Globe batteries give outstanding performance wherever they are used . . . and it's no wonder! Every Globe battery is the result of continuous product research and most scientific methods of manufacture. They're the result of 47 years of actual battery engineering experience . . . 33 years of building quality batteries for autos, trucks, heavy machinery, army tanks.

These are but several reasons why Globe batteries are outstanding everywhere. Performance records prove that Globe batteries stand up extra long, through tough, pounding conditions, severe weather extremes. They prove that Globe batteries are packed with the reserve power to keep engines "spinning" until they catch.

Let the experience of others be your guide to the kind of batteries you install. Always specify Globe . . . the batteries that are built better to serve better!

GLOBE-UNION INC.

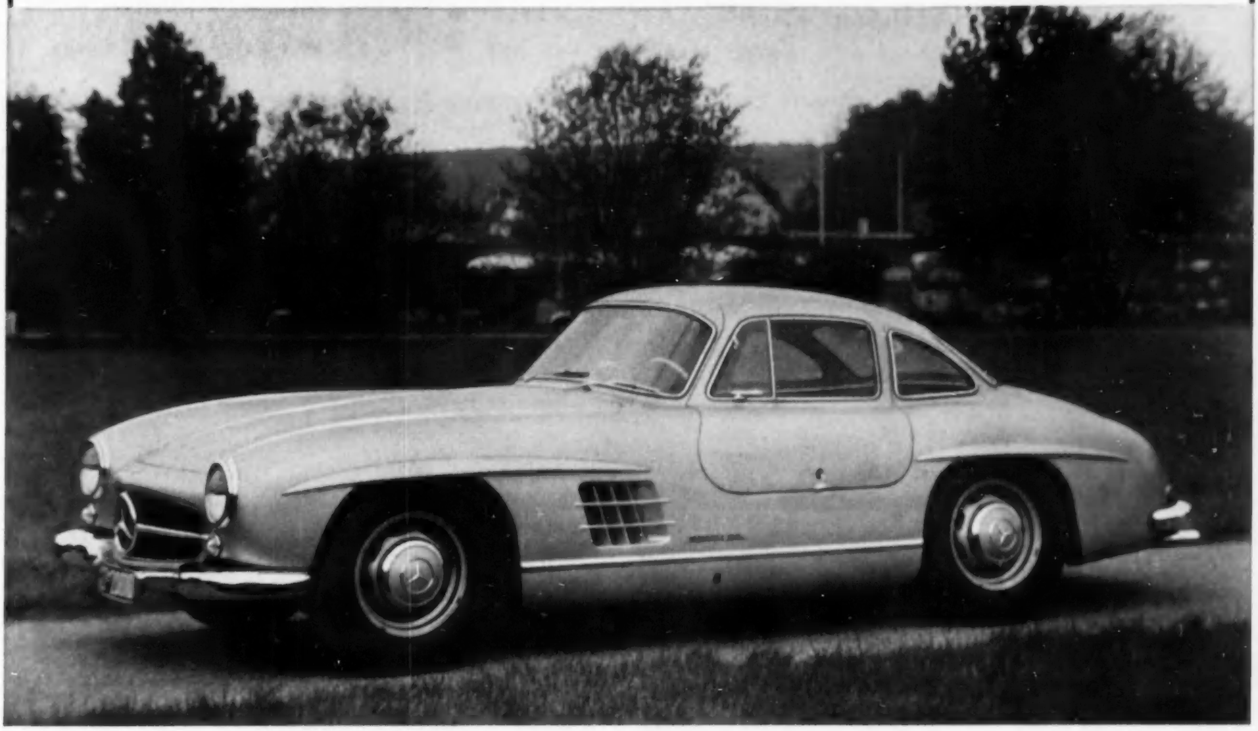
MILWAUKEE 1, WISCONSIN

FOR FAST SERVICE THERE ARE 16 GLOBE BATTERY PLANTS — ATLANTA, GA. • BOSTON, MASS. • CINCINNATI, OHIO • DALLAS, TEXAS • EMPORIA, KANSAS • HASTINGS-ON-HUDSON, N. Y. • HOUSTON, TEXAS • LOS ANGELES, CALIF. • MEMPHIS, TENN. • MILWAUKEE, WIS. • MINERAL RIDGE, OHIO • OREGON CITY, ORE. • PHILADELPHIA, PA. • REIDSVILLE, N. C. SAN JOSE, CALIF. • AJAX (TORONTO) CANADA.

if it's petroleum-powered *there's a* GLOBE-BUILT BATTERY *...right from the start*


NOW—
One Strong Source
Speaking of torque converters . . .
• the most extensive line for industry—capacities from 30 to 600 HP
• Torcon's pioneering design and field experience joined with Clark's reputation in the basic field of transmitting torque to wheels
• a single strong and responsible source—qualified by engineering thoroughness and versatile facilities—
all these basic advantages crystallized in CLARK-TORCON
CLARK® EQUIPMENT
CLARK EQUIPMENT COMPANY • BUCHANAN • Battle Creek, Jackson and Benton Harbor, Michigan

Mercedes Benz Type 300SL, a fast, sleek, precision-built car, is manufactured in Stuttgart, Germany, by the Daimler-Benz Company, the world's oldest automobile manufacturer. It weighs approximately 2,800 pounds and has a maximum speed of 165 miles per hour.



Europe's sleek, glamorous sports cars back up their superb styling with astonishing records for dependability-plus, under the most grueling performance tests.

Part of the reason for this record for dependability lies in the fact that many of these precision-built sports cars use leakproof Bundyweld Tubing for hydraulic brake lines, oil lines, "petrol" lines, other important uses.

Foreign car manufacturers, like American auto makers, have learned that they can always rely on Bundyweld Tubing. Here's why:

Bundyweld is leakproof by test: thinner walled yet stronger; can withstand heavy vibration fatigue, punishing wear; has high bursting strength; takes easily to standard protective coatings. It's the only tubing double-walled from a single metal strip, copper-brazed throughout 360° of double-walled contact.

Bundy's world-wide facilities stand ready to help you with expert engineering assistance; superb fabrication facilities; prompt, on-schedule deliveries, and a sincere desire to help you solve your tubing problems. Call, write or wire.

BUNDY TUBING COMPANY
DETROIT 14, MICHIGAN

Affiliated plants in Australia, England, France, Italy, Germany

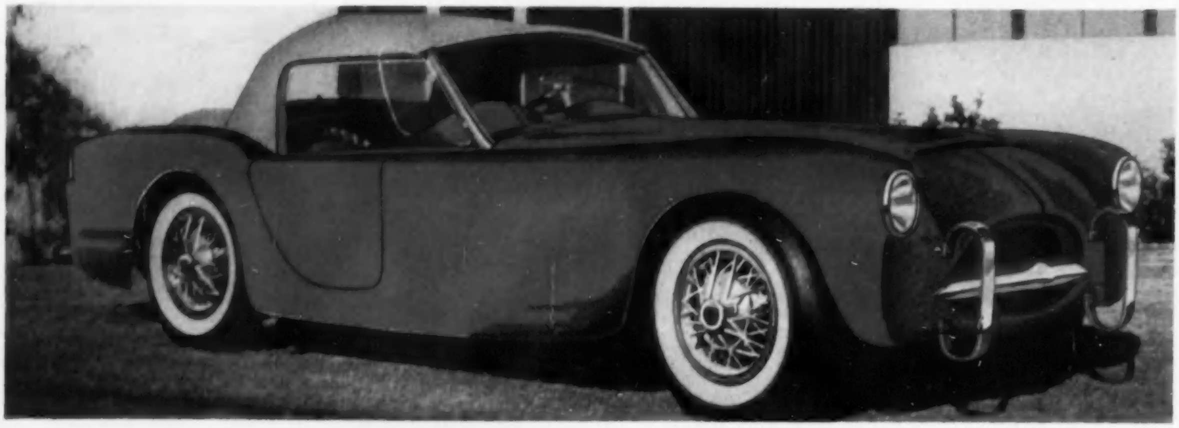
BUNDYWELD TUBING®

DOUBLE-WALLED FROM A SINGLE STRIP

Bundy Tubing Distributors and Representatives: *Cambridge 42, Mass.*: Austin-Hastings Co., Inc., 226 Binney St. • ***Chattanooga 2, Tenn.*:** Peirson-Deakins Co., 823-824 Chattanooga Bank Bldg. • ***Chicago 32, Ill.*:** Lapham-Hickey Co., 3333 W. 47th Place • ***Elizabeth, New Jersey*:** A. B. Murray Co., Inc., Post Office Box 476 • ***Los Angeles 58, Calif.*:** Tubesales, 5400 Alcoa Ave. • ***Philadelphia 3, Penn.*:** Rutan & Co., 1717 Sansom St. • ***San Francisco 10, Calif.*:** Pacific Metals Co., Ltd., 3100 19th St. • ***Seattle 4, Wash.*:** Eagle Metals Co., 4755 First Ave., South ***Toronto 5, Ontario, Canada*:** Alloy Metal Sales, Ltd., 181 Fleet St., E. • **Bundyweld nickel and Monel tubing are sold by distributors of nickel and nickel alloys in principal cities.**

Here's reinforced VIBRIN ...in sport car bodies

• DENT-PROOF • RUST-PROOF • ROT-PROOF
• STRONGER THAN STEEL BY WEIGHT • EASILY MOLDED TO COMPLEX CONTOURS
• SOUND DEADENING • RESISTANT TO OIL AND GAS • UNHARMED BY WEATHER



WHY NOT reinforced Vibrin ...?

... seat frames

... station wagon flooring

... motorcycle sidecars

Seat frames of reinforced Vibrin could easily be molded in one assembly-saving piece ... to body-cradling contours. They'd help eliminate spring squeak ... or, with foam rubber, eliminate springs altogether. And they'd save weight, too.

Station wagon flooring of tough reinforced Vibrin could be molded in one large piece to eliminate dirt-catching cracks. It would never rust, never need painting ... and would insulate against both heat and rattle. What's more, it would take all kinds of rough wear, could be ribbed to support practically any weight.

Motorcycle sidecars of this same material could be formed to any streamlined shape. The unusually light weight would facilitate removal of the sidecar assembly when desired. And they'd be natural heat insulators ... and always pleasant to the touch.

Why not? Why not reinforced Vibrin *dashboards, roof frames for convertibles, splash pans, fender skirts?* Remember, industry is only *beginning* to take advantage of the unique properties this new material offers.

You'd better explore the *many* advantages reinforced Vibrin offers *you*, by writing for more information today.

Naugatuck Chemical

Division of United States Rubber Company
Naugatuck, Connecticut

BRANCHES: Akron • Boston • Charlotte • Chicago • Los Angeles • Memphis • New York • Philadelphia • **IN CANADA:** Naugatuck Chemicals, Elmira, Ontario
Rubber Chemicals • Synthetic Rubber • Plastics • Agricultural Chemicals • Reclaimed Rubber • Latices • Cable Address: Rubexport, N.Y.

Bushings

for many applications

1/4" to 27 1/2" O. D.

Cast bronze bushings are available plain or in intricate designs. Rolled, split bushings can be ball indented, with standard or special seams, oil holes, grooves or cutouts.

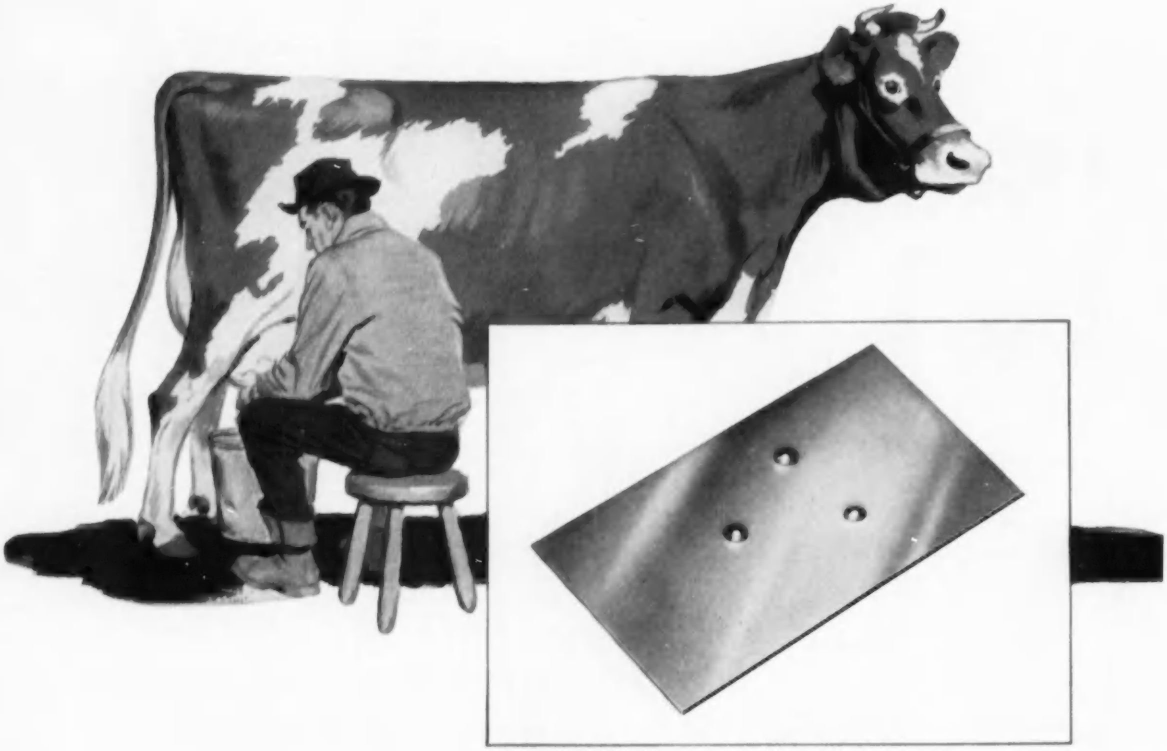
Research • Engineering • Quality Control

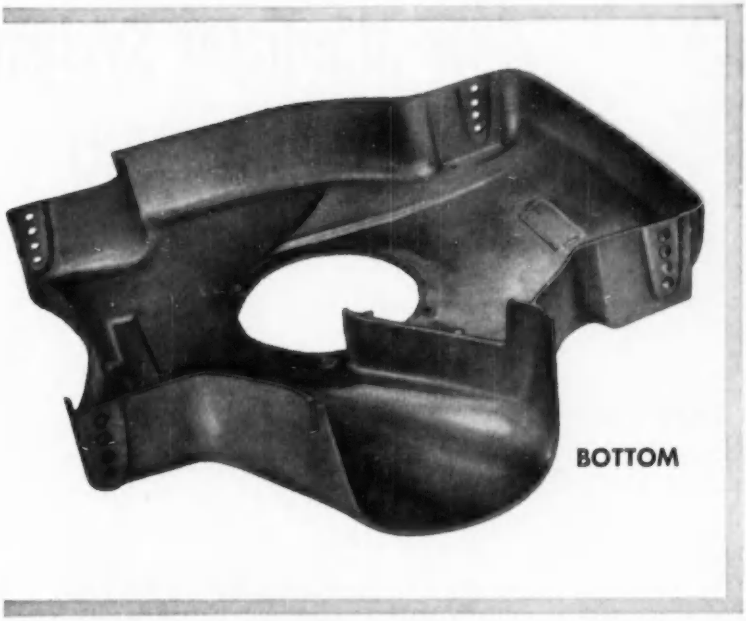
FEDERAL-MOGUL CORPORATION • 11035 Shoemaker, DETROIT 13, MICH.

FEDERAL Mogul

FEDERAL-MOGUL

Since 1899

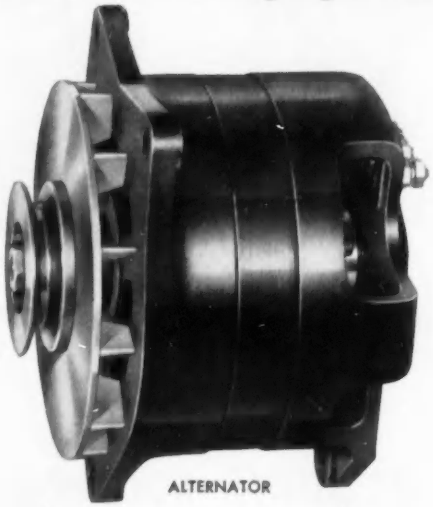



BOTTOM

Leece-Neville

New Alternator System COSTS NO MORE than d. c. equipment

Completely redesigned from end to end, the new line of Leece-Neville Alternators are priced to make the entire L-N Alternator System . . . Alternator, Rectifier and Regulator . . . cost no more than d.c. equipment of comparable capacity.

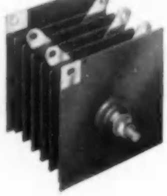


ALTERNATOR

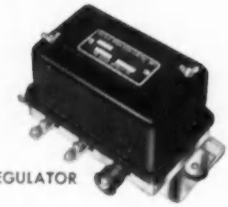
ALL THE ADVANTAGES OF ALTERNATORS

The new Leece-Neville Alternators provide the many, well-known advantages over d.c. generators, including:

- Better performance on the vehicle through higher drive ratio. Alternators may be driven up to top bearing speed. See typical curves below.
- No commutator and no heavy current carrying brushes. Rotating field is excited through two small brushes riding on smooth slip rings.
- Unmatched reliability and long, service-free life. Complete overhaul involves just replacing bearings, slip rings and brushes.



RECTIFIER



REGULATOR

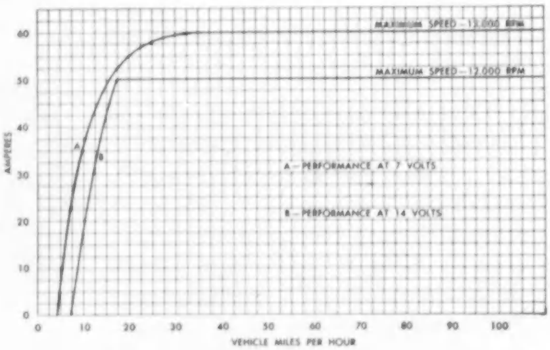
TYPICAL LEECE-NEVILLE QUALITY

In redesigning the L-N Alternator for low cost, volume production, nothing has been skimped. Engineering, materials and manufacturing are all up to the high standard that has made *Leece-Neville* synonymous with *quality* since 1909.

FOR 6-VOLT AND 12-VOLT SYSTEMS

The new line of Leece-Neville Alternators includes models for both 6-volt and 12-volt systems, with a choice of two bearing sizes to meet requirements of the application. All four models are on the same frame with identical external dimensions. System includes new, high density rectifier.

The new line of Leece-Neville Alternators offers the ideal solution for the increasing load of electrical accessories on passenger and commercial vehicles today . . . and tomorrow. For complete data, write The Leece-Neville Company, Cleveland 14, Ohio.



PERFORMANCE AT OPERATING TEMPERATURE

YOU CAN RELY ON Leece-Neville

AUTOMOTIVE ELECTRIC EQUIPMENT SINCE 1909

ALTERNATOR SYSTEMS • GENERATORS • STARTING MOTORS
REGULATORS • SWITCHES • FRACTIONAL HP MOTORS

TRUCK BUS DIESEL OFF-HIGHWAY PASSENGER RAILROAD MARINE INDUSTRIAL

HEAR THE NEWS?

it handles like a one-piece ring!

NEW MUSKEGON

"UNITIZED"

CHROME PLATED OIL RINGS

MUSKEGON Piston Rings

MUSKEGON PISTON RING CO.
MUSKEGON, MICHIGAN
PLANTS AT MUSKEGON AND SPARTA

DETROIT OFFICE:
521 New Center Bldg.
Telephone: Trinity 2-2113

Since 1921... The engine builders' source!

Have *you* heard about Muskegon's great new advance in piston ring design and manufacture? It's really new, different, better than ever before . . . a *multiple-piece* ring that handles like a *one-piece* ring!

Have you heard how it's done? The secret is Muskegon's patented *Unitizing* process that holds the pieces together in the right order for quick, easy installation. Then, as the engine starts to run, the special adhesive dissolves completely in the hot oil . . . leaves the parts of the ring free to function perfectly and independently of each other.

But *seeing* is believing. Test Muskegon's CSR-200 rings in your own engines, in your own laboratory. Discover for yourself how the mirror-smooth chrome plated rails reduce ring wear and bore wear, scuffing and friction. You'll be amazed at the resulting longer engine life and increased oil economy!

Now listen to this: the price of these better rings is just *half* that of chrome plated cast iron oil rings! Isn't that music to your ears? Write today for complete details.

For America's first jet tanker-transport fleet...

AIR CONDITIONING by AiRESEARCH!

Boeing solves cabin comfort problems at new high altitudes and speeds for transports with complete AiResearch systems

History repeats. When Boeing B-29s pioneered heavy bomber flying at high altitudes, AiResearch was chosen to supply the cabin-conditioning equipment required. Now Boeing has again selected AiResearch equipment for its sleek new KC135s.

AiResearch has unmatched experience in developing air conditioning equipment for the majority of present day commercial and military aircraft. It has produced more complete air-conditioning and pressurization systems and components than all other manufacturers put together.

Once more a leading manufacturer confirms that where proved designs, reliability and high performance are required, AiResearch is the choice in its field.

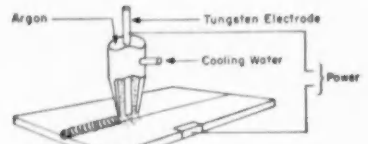
THE GARRETT CORPORATION

AiResearch Manufacturing Divisions

Los Angeles 45, California • Phoenix, Arizona

Designers and manufacturers of aircraft components: REFRIGERATION SYSTEMS · PNEUMATIC VALVES AND CONTROLS · TEMPERATURE CONTROLS CABIN AIR COMPRESSORS · TURBINE MOTORS · GAS TURBINE ENGINES · CABIN PRESSURE CONTROLS · HEAT TRANSFER EQUIPMENT · ELECTRO-MECHANICAL EQUIPMENT · ELECTRONIC COMPUTERS AND CONTROLS

Sound Welds in 33 Seconds ...by HELIARC Welding



Each of the six appendages of these 52S aluminum aircraft manifolds is HELIARC welded to the tubular main section in from 20 to 45 seconds . . . The spatter-free, flux-free HELIARC welds need no cleaning or finishing—costs are kept at a minimum.

The parts are aligned in a special jig, and tack-welded in position using a lightweight HELIARC HW-9 torch . . . The finished welds are made while the parts revolve on an electrically operated turntable controlled by a foot-switch. Since each weld is completed in less than a minute, production rates are high . . . Here are some of the advantages of HELIARC welding:

- Joins nearly all commercial metals including non-ferrous and high temperature alloys.
- Heat highly concentrated within the area of the weld minimizes distortion.
- Makes all type joints in all positions on metals .020 in. and thicker.
- Portable manual equipment, and semi-automatic and automatic units for all job needs . . . Semi-automatic hand-guided HELIARC welding attains speeds up to 50-in. per minute.

Start saving now—call your local LINDE representative for more information and ask for Form 7942, "Modern Methods of Joining Metals."

Linde Air Products Company

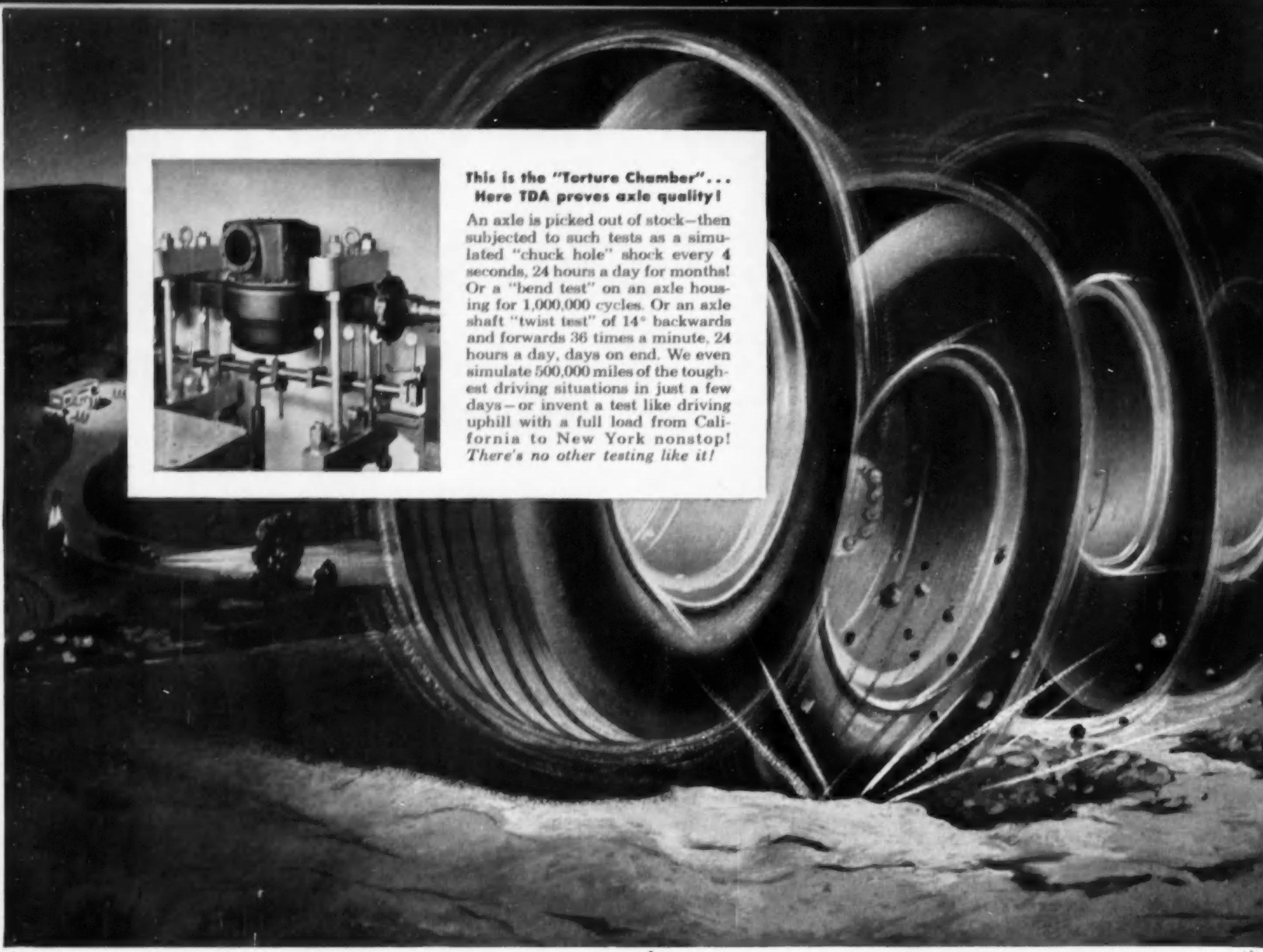
A Division of Union Carbide and Carbon Corporation

30 East 42nd Street UCC New York 17, N. Y.

Offices in Other Principal Cities
In Canada: DOMINION OXYGEN COMPANY
Division of Union Carbide Canada Limited, Toronto

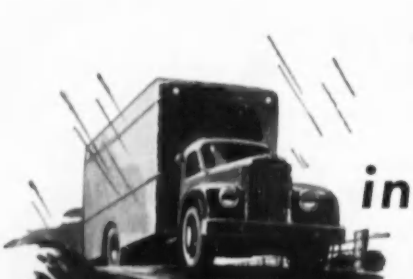
The terms "Linde" and "Heliarc" are registered trade-marks of Union Carbide and Carbon Corporation.

Linde
Trade-Mark



This is the "Torture Chamber"... Here TDA proves axle quality!

An axle is picked out of stock—then subjected to such tests as a simulated "chuck hole" shock every 4 seconds, 24 hours a day for months! Or a "bend test" on an axle housing for 1,000,000 cycles. Or an axle shaft "twist test" of 14° backwards and forwards 36 times a minute, 24 hours a day, days on end. We even simulate 500,000 miles of the toughest driving situations in just a few days—or invent a test like driving uphill with a full load from California to New York nonstop! *There's no other testing like it!*



WE HIT 648,000

in the famous, one-and-only indoor proving ground!

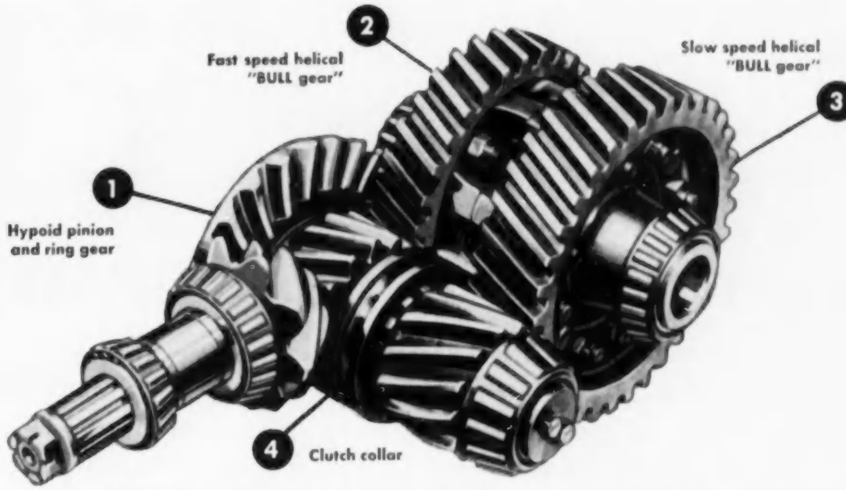
We give axles a merciless beating! Equal the worst possible operating conditions. Then throw in some devilish tests of our own!

It's without equal! Nowhere else does such murderous torture show you *in advance*, how an axle is built to stand it on the job!

We've condensed a multi-thousand acre proving ground into one room in the Timken-Detroit "Torture Chamber." Here, our engineers can put over 50 years of experience to work for you—unsurpassed experience, obtained in building axles for all types of trucks, buses, trailers, farm machinery. Here, we can give stock axles and gearing "the works" *indoors*, to any *outdoor* operating condition—under scientific control and analysis.

How do you benefit? In longer axle life, less maintenance, repairs and downtime; lower operating costs. That's why Timken-Detroit axles are the choice of leading manufacturers and operators.

Meet our "Torture Tester"! With graphs showing speed and torque performance under any operating conditions he chooses—with special dials, recorders and electronic devices—he actually *drives* axles with scientific accuracy from his chair!



EXCLUSIVE DOUBLE-REDUCTION DESIGN...
gives TDA 2-speed axles far greater gear ratio "spread"!

Unequalled Flexibility! Only Timken-Detroit 2-Speed Axles are available in *three* different ratio "spreads" to meet any transmission-engine combination: 28%, 37% or 49%. Unlike ordinary designs that are limited to 37%, this Timken-Detroit Axle selection may be obtained simply by changing the low speed helical gear set.

How TDA 2-Speed Principle Works: A husky hypoid ring gear and bigger, stronger pinion set (No. 1 above) provides the *first step* of the total gear reduction for both fast and slow ratios. Two large, heavy-duty helical gear sets provide the *second step.* Both sets are of balanced size and capacity. One set (No. 2) is for fast speed—the other (No. 3) is for slow speed. The clutch collar (No. 4) moves to left or right to engage one helical pinion or the other. The helical pinion not in use idles.

The Result: Complete elimination of small, complicated parts and midget-size gears! Larger hypoid-helical design gives more teeth in contact—reducing load per unit of contact area—for more positive, quiet operation. Bearings are larger. There's longer engine and truck life. When you divide the total gear reduction, you double its life expectancy. TDA gears operate in either ratio *indefinitely* without overheating.

"CHUCKHOLES" A MONTH

Timken-Detroit Axle

TIMKEN *Detroit* AXLES

TIMKEN DETROIT AXLE DIVISION
ROCKWELL SPRING AND AXLE COMPANY
DETROIT 32, MICHIGAN

The Accepted TDA Co Standard
TRADE MARK REGISTERED

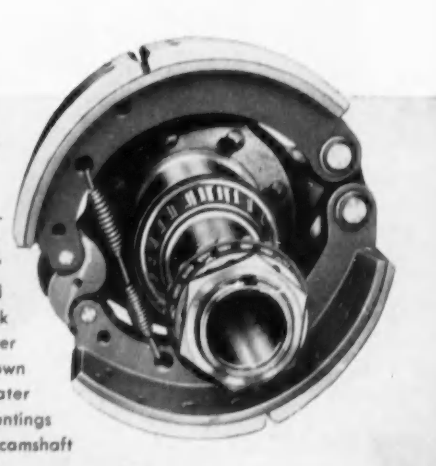
"TORTURE-TESTED"
to Save Money on the Job

World's Largest Manufacturers of Axles for Trucks, Buses and Trailers

Plants at: Detroit, Michigan • Oshkosh, Wisconsin • Utica, New York • Ashtabula, Kenton and Newark, Ohio
New Castle, Pennsylvania

New TDA brake shoes save up to 40 lbs. per axle

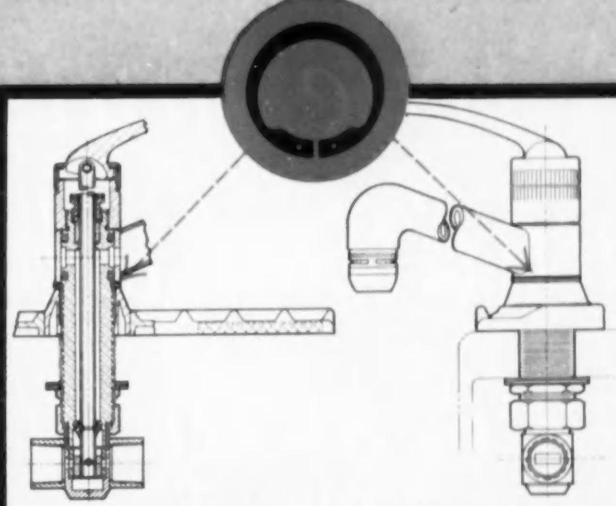
• Lightweight, pressed steel construction to give you more payload plus long wear and safety. Exclusive ¾" TDA "Econoliner" brake liners held rigidly by 12 deep set rivets per block —*not bolts.* Liners are thickest at center where greatest wear occurs—taper down at ends. Result—longer wear, greater stopping ability. New cam roller mountings never seize or brinell. Light nylon camshaft bearings wear up to 4 times as long!



Waldes Truarc ring reduces valve body from $1\frac{5}{16}''$ to $1\frac{1}{16}''$, eliminates chrome plating

GYRO MIXING FAUCET

Single-handle kitchen mixing faucet controls hot and cold water, as well as volume. Radical design has no seals or spindles to replace. One Waldes Truarc retaining ring allows complete assembly and disassembly from either top or bottom of unit.



Aluminum Truarc Ring (external inverted Series 5108) acts as bearing retainer, insures precise alignment of spout and escutcheon, gives uniform shoulder with machining. Truarc ring provides shoulder that would otherwise require machining valve body to 1 5/16" against 1 1/16" used. Also eliminates expensive chrome plating of valve body.

Gyro Brass Manufacturing Corporation of Westbury, L. I., N. Y., uses a single Waldes Truarc retaining ring (Series 5108) both as a positioner and retainer on their Gyro Mixing Faucet. Aluminum Truarc ring not only eliminates expensive machining, but also does away with a chrome plating process that would be necessary if the shoulder were made of the solid material of the body.

You, too, can save money with Truarc Rings. Wherever you use machined shoulders, bolts, snap rings, cotter pins, there's a Waldes Truarc Retaining Ring designed to do a better, more economical job. Waldes Truarc Rings are precision-engineered . . . quick and easy to assemble and disassemble.

More than 5,000 stock sizes of the different Truarc ring types available. Ninety stocking points throughout U. S. A. and Canada.

Find out what Waldes Truarc Retaining Rings can do for you. Send your blueprints to Waldes Truarc engineers.

For precision internal grooving and undercutting . . . Waldes Truarc Grooving Tool!

Send for new catalog supplement

WALDES

TRUARC®

RETAINING RINGS

WALDES KOHINOOR, INC., LONG ISLAND CITY 1, NEW YORK

Waldes Kohinoor, Inc., 47-16 Austel Place, L. I. C. 1, N. Y.
Please send the new supplement No. 1 which brings Truarc Catalog RR 9-52 up to date.

(Please print)

Name..
Title..
Company..
Business Address..
City........................*Zone*........*State*..............

SA-037

WALDES TRUARC Retaining Rings, Grooving Tools, Pliers, Applicators and Dispensers are protected by one or more of the following U. S. Patents: 2,382,948; 2,411,426; 2,411,761; 2,416,852; 2,420,921; 2,428,341; 2,439,785; 2,441,846; 2,455,165; 2,483,379; 2,483,380; 2,483,383; 2,487,802; 2,487,803; 2,491,306; 2,491,310; 2,509,081; 2,544,631; 2,546,616; 2,547,263; 2,558,704; 2,574,034; 2,577,319; 2,595,787, and other U. S. Patents pending. Equal patent protection established in foreign countries.

INTRODUCING:

A true multipurpose additive which sets a new standard of gear lubricant performance.

SANTO

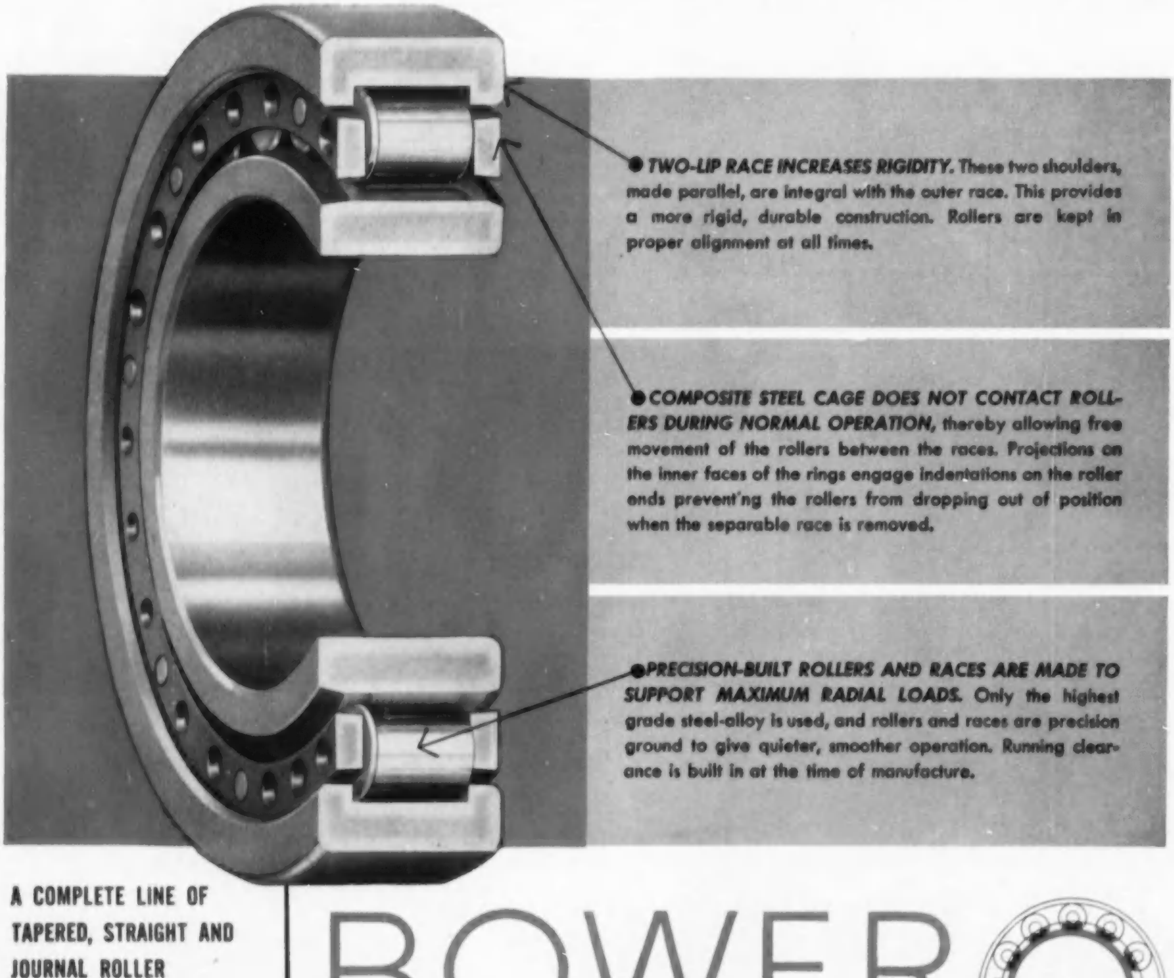
Here's why BOWER straight roller bearings can carry maximum loads—with less maintenance!

The important design features of Bower straight roller bearings shown on this page are just a few of the reasons why these bearings will operate efficiently and economically in your product. Consider these facts, too. Bower straight roller bearings incorporate highest quality materials and workmanship. They have proved themselves capable of standing up day in and day out under maximum loads—with little or no maintenance.

In fact, this is the reason why Bower straight roller bearings are used extensively by leading manufacturers in such fields as automotive, earthmoving, farm equipment and machine tool.

Let a Bower engineer give you full details of the complete Bower line. Call him in while your product is still in the blueprint stage.

BOWER ROLLER BEARING COMPANY • DETROIT 14, MICHIGAN



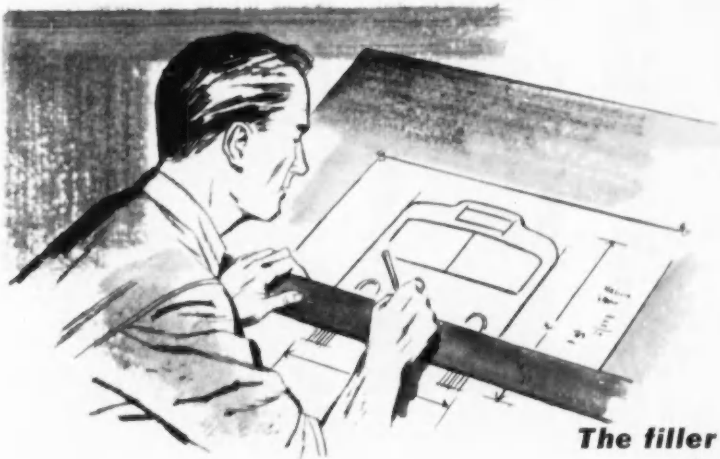
A COMPLETE LINE OF TAPERED, STRAIGHT AND JOURNAL ROLLER BEARINGS FOR EVERY FIELD OF TRANSPORTATION AND INDUSTRY

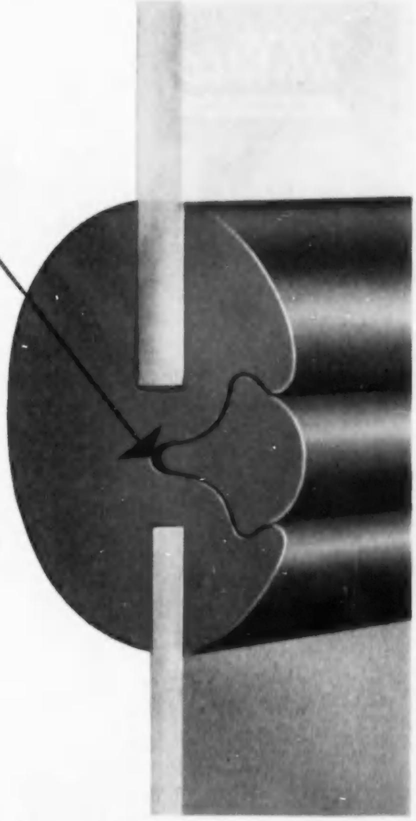
BOWER ROLLER BEARINGS

SPHER-HONED

It's this separate FILLER STRIP

that puts more pressure on the fence and the glass . . . allowing new freedom of design!





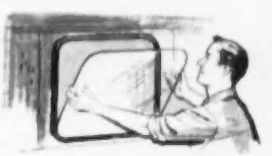
The filler strip makes possible these other Inland advantages!

Today, weather stripping is a "snap". And, it's the snap of Inland's new weather strip that does it! Just think of the design freedom you have—now that weather strip problems are gone. With Inland Self-Sealing Weather Strip, *you need make no provisions for cement, clamps, moldings or channels. You are assured a water-tight seal every time!*

The patented Inland Filler Strip enables the installer to compress the sealing strip *after* the glass is in place. And because it eliminates all the headaches of trying to force the glass into a compressed groove, this is the easiest weather strip to install!

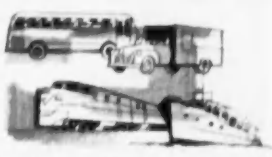
INLAND MANUFACTURING DIVISION
General Motors Corporation • Dayton, Ohio

LEAK PROOF! Permanently leak proof, because it seals both glass and body panel under powerful compression.



EASY GLASS REPLACEMENT! Less lost time for vehicles—broken glass can even be replaced on the road, if necessary.

A POSITIVE SEAL! New filler strip puts more pressure on the fence and the glass—assures complete positive weather proofing every time.

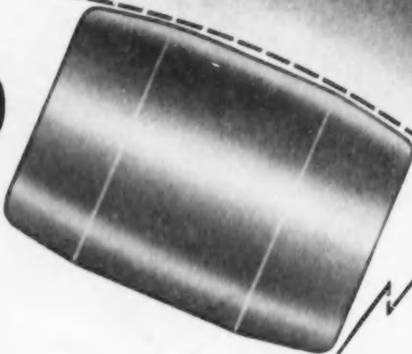


VERSATILITY! Ideal for vehicles, booths, trains, gasoline pumps, buildings, marine windows—for positive, permanent sealing of any window or panel!

INLAND MANUFACTURING

Self-Sealing WEATHER STRIP

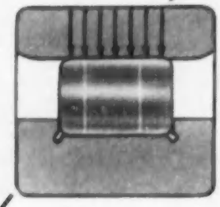
NOW... all Tru-Rol Bearings *have* CROWNED ROLLERS



• When a straight cylindrical roller bearing is under load, the highest stresses tend to concentrate at the roller ends. Stresses may become excessive and cause early bearing failure.

Crowning is a Rollway grinding refinement that adds a long radius curve to the roller ends. This relieves the high stress areas — allows the rollers to take heavier loads and reduces the effect of slight shaft misalignment or deflection. Bearings can be load rated at substantially higher values — provide a longer service life.

Crowning is but one of the many engineering advances built into Rollway Tru-Rol Bearings. Write for the complete story. Rollway Bearing Co., Inc., 541 Seymour St., Syracuse, N.Y.



Crowned roller under full load — stress uniformly distributed.

Carefully selected crown radius, varying from 20" to 260", provides proper relief for normal loading to which bearing will be subjected.

Crowned Tru-Rol Bearings available in the following type:

Stamped Steel Retainer with Guide Lips

Segmented Steel Retainer

Full Roller

+

New Rollway Tru-Rol Catalog features RBEC formula converted to simple nomogram. Send for your copy today.

ROLLWAY BEARINGS

COMPLETE LINE OF RADIAL AND THRUST CYLINDRICAL ROLLER BEARINGS

SALES OFFICES: Syracuse • Chicago • Toronto • Cleveland • Seattle • Philadelphia • San Francisco • Boston • Detroit • Pittsburgh • Milwaukee • Houston • Los Angeles

NEW FJ-4 FURY FEATURES "pump that couldn't be built"

Intended for combat at near sonic speeds, North American Aviation's FJ-4 Fury jet fighter is characterized by thin wings. The carrier-based craft, first flown on October 28, 1954, relies on a new-type Pesco fuel transfer pump and three Pesco submerged fuel pumps.

The U.S. Navy's newest jet fighter, the North American Aviation FJ-4 Fury, uses a revolutionary new Pesco pump in a line-mounted fuel transfer application. This—the pump that couldn't be built—is the first centrifugal impeller type pump ever perfected for such use.

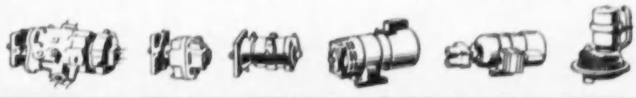
The extremely thin wings of the FJ-4 prevented use of submerged fuel pumps in the wing tanks, so Pesco engineered the so-called "impossible" pump. A radically new Pesco-designed impeller permits the pump to overcome long inlet line losses and deliver a full flow of JP-4 fuel up to 45,000 feet altitude. The pump is instantly self-repriming should it become unprimed during manuevers.

Designed for a 1200 hour overhaul cycle, this motor-driven pump is powered by a Pesco-built DC Electric Motor. Precise and powerful, it weighs only 7.4 pounds and its 11" x 5" x 5" envelope fits into a close-tolerance fuselage location.

Three submerged fuel pumps in the fuselage tank are other Pesco components of the fuel system which supplies the Wright J-65-W4 power plant.

The "pump that couldn't be built" typifies Pesco's continued success in solving difficult aircraft pumping problems. If you have such a problem, take advantage of the development facilities, engineering experience and greatly increased manufacturing capacity of Pesco. Call or write: PESCO, 24700 North Miles Road, Bedford, Ohio.

Model 122913-010 Fuel Transfer Pump was specially developed by Pesco for FJ-4. Able to pump boiling fuel, run "dry" for 15 hours and reprime itself, this pump performs a function previously considered impossible for a line-mounted aircraft fuel pump.



engineering
Pesco
PRODUCTS DIVISION
production

BORG-WARNER CORPORATION
24700 NORTH MILES ROAD • BEDFORD, OHIO


HOTEL SCHROEDER

TABLE IV—Ni-Resist in Engine Liner Service

	Material	Duration of Service	Average Cylinder Wear	Cylinder Corrosion (Water Side)
1.	Chromium Plated Cast Iron	3,000 hours	.008	General corrosion and pitting occasionally through the wall.
	Ni-Resist, Type 2 (160 Bhn.)	2,500 hours	.009	No corrosion, slight discoloration.
2.	Gray Iron (250 Bhn.)	35,000 — 50,000 mi.	.0075	Bad corrosion with pitting often through cylinder wall.
	Ni-Resist, Type 1 (150-170 Bhn.)	100,000 mi.	.0015	No appreciable corrosion, slight pitting.
3.	Gray Iron (220 Bhn.)	50,000 mi.	19 to 1	Standard cylinder block.
	Ni-Resist	50,000 mi.		Ni-Resist cylinder insert in gray iron block.
4.	Ni-Resist	2,000 hrs.	.0005	Full liner in aluminum block.

No. 1 — Heavy duty truck diesel engine hauling ore from pit.
No. 2 — Heavy duty truck diesel engine trailer, road service, West Coast.
No. 3 — Taxicab and light city bus service.
No. 4 — Light duty, high speed engine, air-cooled.

This gray iron Diesel engine cylinder liner (left) used in long distance motor truck service shows bad pitting after some 35,000 miles. By contrast, the Ni-Resist liner at right showed only mild pitting and less wear after 135,000 miles.

Typical example of useful charts and applications from the new NI-RESIST booklet

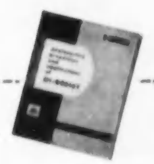
Ni-Resist cylinder liners outlast gray iron 4 to 1 in heavy duty truck service

The above case history on Ni-Resist® cylinder liners is only one of the many instances of improved service in heavy duty truck engines.

Ni-Resist prolongs life of exhaust manifolds and valve guides. Use of Ni-Resist for top ring inserts in aluminum pistons greatly lengthens life, prevents "blow-by" and increases mileage for every gallon of your fuel. Ni-Resist water pump impellers and bodies last longer.

Get the facts about Ni-Resist. See for yourself how castings of this material can extend the life of your engines. Save yourself trouble. Send for this new 64 page Ni-Resist booklet . . . fill in the handy coupon, now.

INCO
TRADE MARK



The International Nickel Company, Inc.
67 Wall Street, New York 5, N. Y.

Please send me booklets entitled "Engineering Properties and Applications of Ni-Resist" and "Buyers' Guide for Ni-Resist Castings."

Name ____________

Title ____________

Company ____________

Address ____________

City ____________ State ____________

THE INTERNATIONAL NICKEL COMPANY, INC. 67 WALL STREET NEW YORK 5, N.Y.

+ INDEX TO ADVERTISERS +

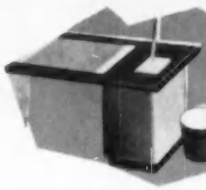
Here's Marvibond*

a new vinyl-to-metal laminating process that gives sheet metal products all these advantages...

- lasting protection against rust and corrosion
- practically any surface effect desired
- superior abrasion resistance
- outstanding resistance to perspiration and most chemicals
- uniform coverage of almost any thickness
- good sound-deadening properties
- less costly fabrication

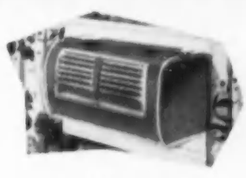
WHY NOT Marvibonded...? ..auto instrument panels and interior trim

vending machine housings



waste baskets

business machine housings



air conditioner cabinets

Window moldings and dashboards of Marvibonded laminates could be permanently clad with vinyl material to match door upholstery and seat trim. And practically any choice of texture is possible–from glare-free matte finishes to rich leather-like grains.

There'd be no checking or flaking, no worries about scratched paint—no need for waxing or other care. The tough, chemical-resistant vinyl cleans with a wipe.

What's more, the vinyl surface would always be warm and pleasant to the touch. Marvibonding ends problems of rust from moisture condensation. And it helps to deaden sound, as well as insulate against squeaks from metal to metal contact.

Why not Marvibonded panels and trim? Plenty of excellent reasons *why*. Excellent reasons why for hundreds of similar applications—like radio and television housings, business machine covers, vending machines, air conditioners, waste baskets, and many many more.

Better see what Marvibond can mean to your product! Write the address below today.

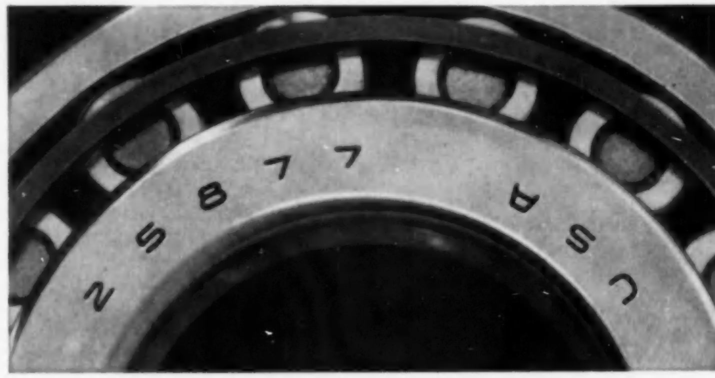
*Pat. applied for

Naugatuck Chemical

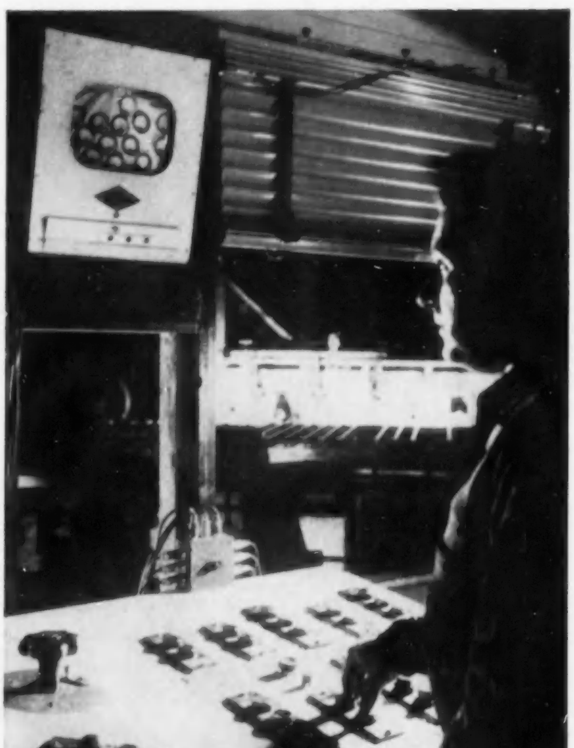
Division of United States Rubber Company
Naugatuck, Connecticut

BRANCHES: Akron • Boston • Charlotte • Chicago • Los Angeles • Memphis • New York • Philadelphia • IN CANADA: Naugatuck Chemicals, Elmira, Ontario
Rubber Chemicals • Synthetic Rubber • Plastics • Agricultural Chemicals • Reclaimed Rubber • Latices • Cable Address: Rubexport, N.Y.

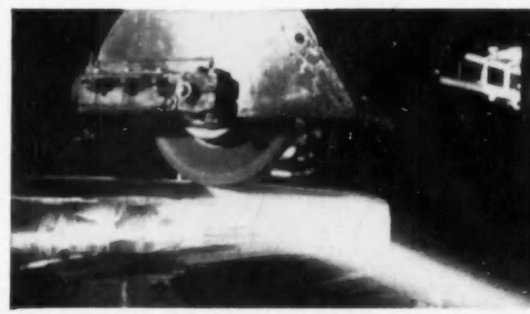
THE NUMBER 25877 on the bearing cone at right—coupled with 25821 on the cup—tells you it's a tapered roller bearing of a certain size used on rear wheels. It doesn't tell you anything about the quality of the bearing or the services that go with it. But the trade-mark "Timken®" stamped on the bearing does.



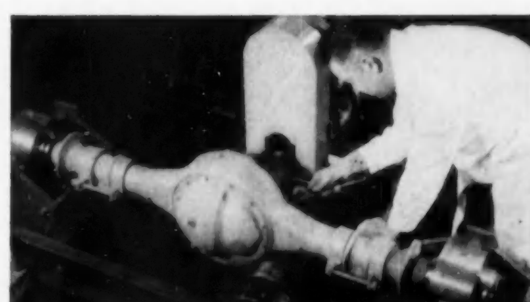
What a bearing number doesn't tell you



WE WATCH OUR BEARING STEEL WITH TELEVISION EYES to prevent it from jamming-up in the furnace during the important slow-cooling process. We use ultra-modern machines and methods like this—in research and production—to make Timken bearings the No. 1 value for your car's moving parts, the vital zone.



WE'RE SO FUSSY ABOUT THE QUALITY of the steel that goes into a Timken bearing, that we make our own. The grinding operation shown above removes surface defects. It's only one of the many quality steps that make Timken steel the finest bearing steel ever made.



WE PUT OUR ENGINEERS TO WORK FOR YOU. One example: in this rear axle oscillating test we run bearings under abnormal load conditions. Result: valuable data that helps car makers get better performance from their Timken bearings. It's another reason for specifying "Timken" with the bearing number. For *full* value always use a Timken bearing cup with a Timken bearing cone. The Timken Roller Bearing Company, Canton 6, Ohio.

TIMKEN *is number 1 for* VALUE *where value counts most... in the vital zone*

NOT JUST A BALL ◯ NOT JUST A ROLLER ▭ THE TIMKEN TAPERED ROLLER ⊂⊃ BEARING TAKES RADIAL AND THRUST LOADS OR ANY COMBINATION